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NOTULÆ AD PLANTAS ASIATICAS.

Part I.

DEVELOPMENT OF ORGANS

IN

PHANŒROGAMOUS PLANTS.

BY THE LATE

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The Editor is responsible for all the errors the following papers may exhibit, in printing and arrangement.

He is indebted to Dr. Wight for advice and assistance, but distance prevented his availing himself of such valuable aid to the extent that would have been desirable.

He is likewise indebted to Capt. William Munro, H. M. 39th Foot, for most of the following list of Errata, as well for other typographical corrections which have been taken advantage of before some of the sheets were struck off.

ERRATA.

Page 35 line 16 from top, 36 line 4 from top, } for *connectif*, read connective.
44 line 2 from top, for *stigma*, read stigmatic.
„ line 12 from top, for *pollenia*, read pollinia.
74 line 6 from top, for 40, read 44.
„ line 4 from bottom, for *is*, read are.
75 line 8 from bottom, for *carpillary*, read carpellary.
„ line 10 from bottom, for *infundifuliform*, read infundibuliform.
85 line 17 from top, for *antheria*, read antheras.
95 lines 11 and 14 from bottom, read mamilla and mamilliform.
98 line 13 from top, for *Papaveracious* and *Ranunculacious*, read Papaveraceous and Ranunculaceous.
99 line 9 from bottom, for *eary*, read early.
102 line 4 from top, for *amylacious*, read amylaceous.
„ line 16 from top, for *lacineæ*, read laciniæ.
107 line 13 from top, for *of*, read to.
113 line 9 from bottom, for *nuceller*, read nucellar.
114 line 15 from bottom, for *membraneous*, read membranous.
121 line 12 from bottom, for *foramin*, read foramina.
132 line 11 from top, for *Pollenia*, read Pollinia.
134 line 1 at top, for *unsexual*, read unisexual.
138 line 5 from top, omit and.
153 line 9 from bottom, 180 line 8 from bottom, } for *Anguria*, read Anguina.
161 line 4 from bottom, for *crumping*, read crumpling.
175 line 16 from bottom, for *Ægialites*, read Ægialitis.
177 line 4 from bottom, for *Curin*, read Cur in.
186 line 11 from top, for *albumenary*, read albuminary.
192 line 3 from top, for *in Compositæ*, read in other Compositæ.
196 line 11 from top, 238 line 6 from top, } for *monocotyledones*, read monocotyledons.
210 line 10 from top, for *Castineæ*, read Cistineæ.
218 line 2 at top, for *Nympæaceæ*, read Nymphæaceæ.
226 line 1 at top, for *scare*, read scar of.
228 line 16 from bottom, for *pinnate*, read pinnatum.
229 line 4 from bottom, for *Leriodendron*, read Liriodendron.
„ line 1 from bottom, for *imbriated*, read imbricated.
233 line 15 from top, for *a quatic*, read aquatic.
238 line 5 from top, for *in*, read is.
„ line 9 from bottom, after *fanciful*, insert as.
239 line 11 from top, for *Hæracium*, read Hieracium.
240 line 20 from bottom, omit of.
4 line 10 from bottom, 182 line 8 from bottom, 191 line 18 from bottom, } for *aborigine*, read ab origine.

DEVELOPMENT

OF

PARTS OF THE FLOWER

IN

Phænogamous Plants.*

The following conclusions may be drawn from the *Jonesia.*

That the axillary floral disc or growing point is quite indistinguishable from the growing point of the inflorescence. That it is quite entire at first, and, as in all other cases, has a lubricate shiny cellular appearance.

That the outer teguments are then pointed out by puncta.

Then the anterior and posterior parts of the calyx : then two lateral parts, the 5th (posticous) appearing later.

That the stamina are then pointed out by prominences.

Lastly, the centre of the disc is elevated into the rudiment of the pistillum.

That the composition of the 4th or posticous sepal mature, is pointed out directly by the development : that it is composed of the posticous one, pointed out at the same time with anticous, and the 5th innermost lateral one.

* The illustrations will appear separately, being now in course of preparation.

That the pistillum is developed entirely as the other parts, first by a prominence or point on the centre of the disc, the convolution first indicated by a furrow.

That in all respects it is a leaf folded on itself.

That the stamen is at first a point, then a cellular grumous body, homogeneous and homo*visious :* that the first change is an opacity (by air ?) of the part along the centre extending from below upwards, and a transparency of the margins : that this subsequently reaches to the apex.

That the anther is first formed, the filament afterwards.

JONESIA ASOCA.—Pl. 1.

0, 0. Bud in its earliest stage.
1. Bud and its bracteæ much more developed.
2. Same, posticous or upper face.
3. Same, bracteoles spread out, anticous or under face.
4. Same, bracteoles for the most part cut away, anticous sepal spread back to shew the imbrication.
5. Same, anticous sepal in situ.
6. Same as 4, but sepals anticous and outer lateral spread out.
7. Base of calyx now very short, and genitalia, not yet perigynous (!)
8. Stamen in front.
9. Pistillum and base of flower.
10. Transverse section of ovarium.
11. Pistillum opened out a little along ventral face.

1*a*. Apex of growing point, 2 bracteæ deflexed, with each an axillary floral disc.
2*a*. Bractea deflexed and its floral disc.
3*a*. Bractea erect, and its floral disc, shewing the first puncta of the bracteoles on the latter.
4*a*. Floral disc, with outlines of two lateral bracteoles.
5*a*. Same, more advanced.
6*a*. Do. bracteoles spread out a little.

6*b*. Flower bud in axilla of bractea, the bracteoles now imbricated.

7*a*. The same, the posticous face and bractea removed.

7*b*. Floral disc taken out from between the bracteoles, with outlines of the anterior and posterior sepals.

7*c*. Another bractea and its flower bud of the same period.

7*d*. Bud removed from axilla.

7*f*. Bracteoles opened out, on the floral disc are seen the rudiments of the anterior and posterior sepal.

7*g*. Bud and its bractea more advanced.

8*a*. Same, removed from bractea and viewed on anticous face.

8*b*. Same, bracteoles spread out, shewing the floral disc with rudiments of 4 sepals.

8*c*. Floral disc removed.

8*d*. Floral disc removed, the origin of the 5th sepal subsequently united to the anticous from the 4th or anticous ? of mature flower.

9*a*. Flower bud more advanced, filling the whole sinus of the bractea.

10*a*. Bractea cut off.

11*a*. Bracteoles removed, shewing imbrication of sepals.

12. Sepals spread out, the union between the outer posticous and the innermost lateral of right side has now taken place.

13. Genitalia separated.

14. Stamen, 15 ditto $\frac{1}{10}$ M.

16. Ventral face (or anticous ?) of pistillum.

17. A little more advanced, corresponds to No. 12.

18. Stamen.

19. Pistillum.

20. Transverse section of ditto.

Jonesia occasionally varies with two ovaria, most of the instances remarked had the carpella anterior and posterior; in all the 2nd ovarium proceeds from the base of the normal

one. See figs. 21, *b. b.* the second ovarium is here not yet united at the base, but at *a. a.* union has taken place.

In one instance the 2nd ovarium presents a bract-like leaf, about $\frac{1}{2}$ as long as the normal one, and united to its ventral suture, to which it is opposed.

All sorts of variety in size occur, from rudiments of ovary, to two complete ones; generally the more complete the one, the larger the other.

In one instance, a third smaller ovarium was observed to be developed.

It is worthy of remark, that the ovaria are sessile at first at the throat of the calyx, the adnate pedicle is therefore a branch, the free portion subsequently developed is rather analogous to a petiole.

When two ovaria are developed, the woody matter of the stalk forms a complete circle. *b.* figs. 22; a stalk of an ordinary one.

PASSIFLORA KERMESINA.—Pl. 2.

Main Results.—That the stipulæ are to be considered as the lowermost pinnæ of the leaf, as they appear subsequently to the central punctum (!)

They are also oblique, an argument in favour (?) of their being lateral.

That general hypogynism exists aborigine, and indeed up to a late period.

That the lobes of the leaf are in every respect developed as the pinnates of a pinnated leaf, from which they are not to be distinguished except by a broader laminiferous base.

[N. B. To examine the development of the lateral laminæ.]

That the toothings are dependent upon the form of the cellular matter, and independent of the veins.

That the stalk of the ovarium, and common stalk of it and the stamens are ulterior, especially the last.

That the tube of the calyx is ulterior.

That the processes or ciliæ are ulterior, neither appearing until the ovulæ have commenced being coated; and the anthers so far perfected as to present parent cells, with 4 ovary granules and proper coats.

Mr. Lindley says, because normal metamorphosis is centripetal, the ciliæ are petaloid rather than staminal. But they are between petals and stamens, consequently of centripetal metamorphosis; but normally they belong to the stamens.

Observation, which does not rely on lucky chances, and which argues from things (seen by the eye,) not things imagined (seen by the mind,) proves that they are neither one nor the other.

IV. 1. Flower bud, sepals removed.
2. Same, petals and two stamina removed, shewing the first outlining of the pistillum.
3. Stamina in front.

V. 4. Similar view of a more advanced pistillum.
5. Vertical view of pistillum.

VII. 6. Flower bud.
7. Ditto sepals removed.
8. Ditto and petals removed.
9. Pistillum and two stamina.
10. Pistillum long section carried through the base of the calyx.
11. Transverse of ovarium.

VIII. 1. Base of calyx. Stamina in situ and pistillum.
2. Long section through pistilla, etc., one stamen remaining.
3. Ovula of same.
4. Double long section of base now tube of calyx, stamina and base of pistillum: this is rather earlier than 1; it shews the filaments to be cellular processes from the inner lining of the tube of the calyx, and therefore analogous to

hairs, although perhaps from their being a growth from an inner lining which is continuous with the stamina or outsides of the filaments, they are perhaps of a glandular nature, and in this respect representatives of indefinite stamina ?

Results. That the pistillum first appears as a mere rim of an obsolete nature, from which it passes into a short hollow three-lobed body; the lobes concave, each representing a carpel leaf.

(Q.) That the tube of the calyx and the ciliæ appear simultaneously, neither being found in 9 or 10.

That their late appearance and irregularity connected with their outside station, is proof that they are not *staminal*, but mere cellular processes from the tube of the calyx, the lowermost down the tube are the largest, and most irregular.

That the placentæ are marginal, and that the ovulæ are produced immediately from their surface, which is nearly equal in extent to the more ventral part of each leaf.

The processes are of late appearance, the sepals being hooded, the stamens sulcate down the middle, the petals rather larger, the pistillum a three-lobed disc before any signs of processes (! !)

Now bear in mind, this retrograde development, what does it mean ? for in some instances the stamens are formed before the petals (?)

The development of the carpels is precisely that of ordinary leaves, the punctum first, the lamina and involution last.

So up to a certain time the development so far as regards the flower, is regular enough.

The processes are the result of ulterior development, so is the stalk or gynophore, for when the bud is well developed, and the ovula even have appeared, nothing is seen but 5 stamens, 5 petals, 5 sepals hypogynous.

An excellent opportunity is here afforded for examining the

development of the veins of leaves. The first change is the lining out of the new veins, at least on the circumference from extension of those more developed; this lining out depends apparently rather on a want of opacity or cessation of action, than on any distinct production.

Then into these, lines of a more diaphanous nature pass the vessels, it may be inferred by extension, although some vessels are seen lined out and barred without any apparent connection with the more developed ones; this transparency of the reticulations is at first slight, afterwards just when the vessels may appear it is so distinct as to seem as though formed by a proper canal.

The parenchyma has a mucilagino-cellular appearance, and the cells contain plenty of chlorophyll.

The margin is thick mucilagino-cartilaginous looking, of 2, 3 series of perpendicular cells, and is thickest over the teeth.

In a very young state the flower is axillary to the left hand stipule, the cirrhus a short point, evidently axillary to the leaf.

Although the cells even of the disc are well marked out under $\frac{1}{550}$ * M., yet they do not present a hyaline appearance; the appearance is that of mucilage.

Stipulæ here belong to the leaves, because the leaves are produced first.

The central lobe first entire, then two minute prominences; at this state an entire broad cushion-like disc occurs in the axilla!

Then the disc becomes oblique and sub-bilobed, the lobe next the leaf opaque, becomes a cirrhus, the outer lobe the lowermost and largest bractea, the part between is developed into the flower.

Hence the cirrhus is evidently belonging to the inflorescence.

The cirrhus is entirely axillary.

* These figures, it may be presumed, represent the focal distance of the magnifying power applied to be 550th part of an inch.

PASSIFLORA KERMESINA.—Pl. 3.

Stage I.—1. Bud: one stipule removed, *a.* leaf, *b.* tendril, *c.* flower bud.

2. Flower bud detached, *a. a. a.* bracteæ, *b. b.* sepals.

3. Same, bracteæ removed.

4. 5. 6. Ditto, various views.

At this period the leaves are conduplicate, the lamina a mere strip on either side of centre of midrib, the bracts have no distinct margin, and one central bundle of vessels, from which a few rudimentary veins proceed chiefly on the largest side. No trace of division of the floral disc.

Stage II.—1. Bud, etc. one stipule removed, *a.* leaf, *b.* cirrhus, *c.* flower bud, *d. d. d.* bracteæ.

2. Flower bud, *d. d. d.* bracteæ, *e.* sepal.

3. Same, bracteæ removed, sepals now distinctly carinate.

4. Bud, two sepals removed, *a. a. a.* sepals, *b. b. b. b. b.* petals, *c. c. c. c. c.* inner 5-lobed undulated annulus: origin of stamina.

Sepals now *veinless;* margin of stipule developed teeth, glandular looking, lamina more reticulate, bracts with slight tendency to be toothed: with one central but no lateral veins; in outermost ones the vein is complete nearly to the apex.

Stage III.—1. Flower bud.

2. Same, bracteæ removed.

3. Same, 3 petals removed.

4. Vertical view, staminæ and petals.

5. Petals removed.

Stipules,

VI. Considerably advanced.

1. Flower bud; 2, same, bracteæ removed.

3. Same, sepals removed; 4, do. another view.

5. Do. petals spread out; 6, view of flower.

2. Anterior petals deflexed; 3, staminæ removed.

7. Stamina in front; 8, do. back; 9, transverse section.
10. Pistillum.

Sepals now cucullate; petals *veiny*, but still only one central vein vascular from the base to the middle; others disappear from pressure. The further progress of change is as follows: development of vessels from base upwards; commencement of separation of inner tissue of anther *cells;* ovarium hollow, cavity subregular (!) ovules none.

Passiflora Kermesina.

Development, Continued.—Pl. IV.

1. Apex of a branch, on the left is a young punctum of a leaf, on the right a larger one, with another by the side of the corresponding stipule.
2. The same points, containing more parts; a leaf and 2 large stipules, and a smaller leaf with smaller stipules.
2*a*. The larger leaf of the same in front, the two rudiments of the future lobes are shewn.
3. Same points, another view; the larger leaf and larger stipules only seen.
3*a*. The leaf of another, from the same points; one stipule, and axillary disc viewed rather obliquely.
4. Leaf and axillary disc, more advanced.
4*b*. The same, more magnified; the lobe of disc next the leaf becomes the tendril, the other lobe the outermost bract.
4*a*. The axillary disc detached, *a*. *tendril*, *b*. outer bract.
5. Leaf and stipules with young flower bud and tendril, in front.
5*a*. Future tendril and young flower bud separated, on the latter the inner and smaller punctum indicates the second bract.
5*b*. The same, outer bract in front.

6. Same as 5, but with two flower buds developing, which is a very rare occurrence.
7. Same laterally, stipules removed.
8. Larger flower bud *in front*, viz. tendril face.
9. Same, flower bud detached.
10. Smaller flower bud.
11. Portion of a stipule shewing the way in which the veins or ducts of veins are developed ; first of all, their courses indicated before the vessels make their appearance.

Results.

That the tendril is especially part of the inflorescence, and that it is developed from the axillary floral disc.

That the leaf puncta appear before the stipular puncta, and that these seem to belong to the leaf in *ab origine.*

That the leaf punctum is first entire ; that the lobes are lined out when the leaf is entirely cellular ; that the stipulæ are entire originally, and indeed up to a latish date.

That the bracteæ are indicated by successive puncta.

That the vessels of the veins of the leaf are developed first in the midrib, then in the veins next to it, thence to the margin ; that their course is first indicated by transparent lines, then the vessels appear, sometimes it would seem independently, i. e., not extended from previous ones.

DENDROBIUM DALHOUSIANUM.—Pl. v.

April 22nd, 1843.

A. I. 1. Very young bud, with a bit of axis, bud $\frac{1}{6}$ line long.
2. Same, bud detached : 2 sepals spread out, petals in situ.
3. Same, anticous sepal 1 lateral petal, labellum, & anther.
4. Anther, etc. in front, the dark space at the base is the the anticous stigma.
5. Anther a tergo.

A. II. Bud rather more advanced.
6. Bud seen laterally.

7. Ditto anticously.
8. Ditto with the sepals removed.
9. Ditto with the lateral petals deflexed.
10. Ditto ditto lateral view.
11. Anther and summit of ovarium in front, three stigmatic puncta ($\frac{1}{616}$* M.) lateral stamina.
12. Same, laid open, the placental lines alternate with biggest or anticous lobe of stigma. See *aa. bb.* lateral stamina (?)

A. III. Much more advanced.

13. Bud laterally.
14. Ditto ditto.
15. Bud-labellum, one lateral petal and all sepals removed, the stigmata well developed, two in front emarginate, third in the back furrowed down the middle.
16. Labellum in front.

Results.

Original equality and regularity of sepals.

Ditto ditto ditto petals.

Primary development of anticous stigma, then of 2 posticous, then their emargination.

Complete abortion of lateral stamina.

Conformity of young anther with 4 locellar type, altogether.

The latest irregularity is the obliquity of lateral sepals.

Epigynism very early.

DENDROBIUM DALHOUSIANUM, *Continued.*—Pl. VI.

B. I. 1. Bud, 6 lines long (with ovary,) dorsum.

2. Ditto laterally, shewing commencing obliquity.
3. In front, sepals removed.
4. Lateral, 2 petals removed.
5. Back view of column and front of labellum.
6. Front of column.

* See note p. 7.

7. Ditto, laterally.
8. Ditto, laid open.
9. Placenta of the same.
10. Transverse section of anther.
11. Cells composing the yellowish masses.
12. One of the masses (detached bit of $\frac{1}{4}$ ln.) shewing it to be enclosed in or surrounded with a cellular coat.
13. Much younger bud, back of anther, labellum in situ.
14. Same laterally.
15. Oblique view of column and anther, *a. a.* lateral stamina, *b.* third or anticous stigma, *c.* lateral stigmata.
16. Same in front, the same letters have the same reference.
17. Half an anther, transverse section, the yellow part confluent: also continuous with the cutis, consisting of irregular masses of cells: adhering, and each containing a nucleus. Vide 18.

Ulterior obliquity of sepals, dependent on prolongation of base of labellum, subsequent emargination of all the stigmata. See fig. 6 *a. a. a.*

Results.

Late appearance of lateral staminæ, a sign of their belonging to another series.

Order of Development.

1. Sepals.
2. Petals.
3. Stamen.
4. Stamens.
5. Carpels.

DENDROBIUM DALHOUSIANUM, *Continued.*—Pl. VII.

C. 1. Column much more advanced, the original stigmata still visible at *a. a. a.* each now emarginate.
2. Transverse section of anther ditto.
3. Portion of pollen mass, outer ends of circumferential grains tipped with a waxy yellow substance, the remains of original cellular tegumen ?

3a. Some grains distinct.

4. Vertical view of the apex of the ovarium; sepals and petals removed, *a. a.* lateral stamina, *b.* anticous stigma, *c. c.* lateral stigmata.
5. Very young bud, puncta of sepals forming.
6. Vertical view of ditto.
7. Vertical view of the termination of the sexes of same.
8. Vertical ditto of another, rather more advanced.
9. Young bud seen posticously, sepals removed.
10. Some petals and sepals removed in front, *a. a.* lat. stamina.
11. Same viewed more vertically, *a. a.* lat. stamina, *b.* cavity of the ovary.
12. More advanced, costæ of ovary now commencing, as likewise superiority of perianth.
13. Back view of the same, sepals removed.
14. Front of ditto.
15. The same, labellum and lateral petals spread out. No stigmata now.
16. Very young ditto, *a. a. a.* sepals, *b. b.* petals, *c.* labellum, *d.* stamen, all seen posticously.
17. Same, seen anticously, labellum not seen.
18. Same, vertically; the same figures have the same references.

Results.

Original regularity and equality of sepals and petals.

The development seems to be thus:

1. Sepals.
2. Petals and stamen, which earlier is larger than the petals.
3. Anticous stigma, and lateral stamina, last lateral or posticous stigmatic punctum.

The stigmata are entire at first, afterwards becoming emarginate.

The pollen seems to be thus: 1st the anther is generally cellular, then pressure separates molecular grumous stuff.

Then the subsequent pollen mass is completely lined out, it is cellular, and enclosed in a cellular tegument. At this time nitric acid resolves it into masses of nucleary cells; then these enlarge, become separated, and then divided into 3 or 4: original tegument adheres, but not continuously to the outer ends of the outermost cells.

Trewia.—Flos Fæmineus solitarius ex axilla folii, basi 1-bracteatus.

Calyx tubulosus, 4, 5, 6-dentatus, demum lateraliter fissus.

Ovarium liberum, stylo robusto 3-4-partito, laciniis varie tortis, stigmatibus plumosis, faciem internam styli occupantibus; 3, 4-loculare: ovulo cuivis loculo unico, pendulo, foramine placenta fungoidea obtecto hilo propinquo. Tegmentis binis.

Arbor mediocris vel parva, ligno albo [molli] in partibus novellis pilis stellatis insignita, gemmis squamis tectis.

Folia opposita vel subopposita, cordato-ovata. Vernatione conduplicaté involutiva ?

Stipulæbinæ cuique folio, lineari-setaceæ, deciduæ.

In Peepuls there are two stipulæ of convolute disposition the *same as that of leaves:* is there a general relation between the venation of the two ?, one is obviously with the other, so they are really alternate.

Entering into the nature of stipules, etc. I believe this is the only instance of a plant having opposite leaves, and the ordinary form of stipulæ, by which I mean two leafy appendages to each leaf.

The tendency to intrapetiolar stipulæ among opposite leaved plants would appear to be great, from the circumstance of an Urticaceous plant with opposite and alternate leaves, in which the opposite have intrapetiolar, the alternate the ordinary form.

And although this would appear a marked instance of the composition of intrapetiolar stipulæ, I am not disposed to consider it more than a special instance. Stipules of

Rubiaceæ, Rhizophoreæ and Dipterocarpeæ are simple leaves, acting as scales to the buds.

Divisions of stipules.

Spurious stipules, mere processes of the petiole, as Rosaceæ; ochreæ, *stipulets* of Leguminosæ.

True ditto, having a distinct connection with the axis, on a different plane from the leaf or leaves, and performing the functions of scale-buds. Bucklandii, Rubiaceæ.

Intermediate connection with the axis very rudimentary, no function, Euphorbiaceæ, Rhamneæ.

In conformity with these definitions botanists have been singularly consistent in considering all stipulæ to be double organs, although they may present no trace of composition, and although the line of insertion may be upon a plane above that of the leaves to which they are referred. The same supposition of their being always double organs, and consequently always having a numerical relation with their leaves, afforded ground for Mr. Lindley, to question the nature of the so-called stipulæ,—a question disputed by Mr. Bentham, who seems inclined to be of opinion that the number of parts forming stipulæ may have an increased numerical relation with their leaves.

In the latest works, such as that of Adr. Jussieu, the stipulæ are considered as forming part of the leaf.

The study of development however, which appears to be the most accurate way of ascertaining the nature or degree of composition of organs, appears to me to warrant the supposition of stipulæ belonging to leaves, and being double organs in a comparatively small number of cases only.

It appears to me that the advocates of the stipuline nature of parts of the whorls of Stellatæ will have considerable difficulty in explaining such instances as Rubia cordifolia, in which the parts of the whorl are 4, all petioled, and if these are leaves the others are so exactly alike in development, etc. as to be leaves also.

* *

For it appears highly probable, that an organ formed by the union of two distinct limbs should have exactly the same venation as an organ formed of simple origin, and still more that the composition should allow such a degree of imitation of a leaf, as to admit of the structure of a *petiole.*

Trewia has the male flowers and habits of Euphorbiaceæ, such as Croton: it also tends hither by its occasionally having 3 carpella.

It has the calyx perhaps of Urticeæ, and certainly the stigmata, but all Urticeæ have simple carpella ; so has Trewia sometimes, its rudimentary ovary has been seen by others, as well as myself.

In the nature of the ovarium, in the fungoid production of the placenta, and the ovulum generally, it approaches Euphorbiaceæ and Scepaceæ.

In two instances the additional female flower has been reduced to a stalk bilobed at its apex, each lobe having its two stigmatic lines, and consequently it is to be inferred that the ovarium would have been binary, two vascular fascicles in the stalk, one to each style.

As in this case there was no cavity whatever, while the stigmata were tolerably well developed, it is adducible as a proof of the greater permanence of the style and stigma to the other parts of a carpellary leaf.

In another instance the female was more developed, consisting of a solitary carpellum, the stigma and style were well developed, but there was an apparent tendency to openness of the ovarium, as if one margin had been inflected, the other lapping over it, such as would result from making an ovarium from a leaf with the ordinary venation.

It is obvious from the situation of these additional ovaries, that they belong to a different flower from the more developed one. Did they belong to the same flower, the suture would have the same direction with the stigmatic furrows of the perfect flowers ; whereas, it is just the contrary.

In one instance, a single stamen was developed on one side of the additional flower.

Hence it is worthy of enquiry, whether the so-called calyx is not rather an involucrum.

The presence of the bractea on the pedicel proves that the inflorescence is not simple from the axilla of the leaf, and the occasional presence of another flower with another bractea shew that the inflorescence approaches in nature to that of the males.

Q.—Is the terminal flower of a raceme naked or suffulted by a bractea?

The calyx differs markedly from that of the male flowers; it is tubular, irregularly 4, 5, 6-toothed at the apex, when 4-toothed the divisions alternating with the stigmata: it is subsequently ruptured by the growth of the styles and stigmata. I believe its æstivation to be reducible to the valvate form.

It may be here enquired whether the greater part of the instances of ruptured perianth (rupture commencing at the apex), do not occur in valvate æstivations: the margins cohering firmly, and subsequently giving way in the direction of one of the teeth.

The instances of calyptrate perianths, petals, etc. such as those of the Myrtaceæ, Vitis, etc. all rupture at the base.

The structure of the pistillum is in some respects worthy of remark; it is composed generally of 4, occasionally of 3 carpellary leaves, the composition of entrant portions of which is not distinguishable. These do not coalesce in the axis towards the apex of the fruit, but a small space is left there. If the septa are pulled apart, each separates with a portion of the placenta, which is above the ovule produced into cellular lobed growth, covering pretty completely the foramen of the ovulum. These placentary processes have a marked resemblance with the processes of the stigma!

In the young pistillum there is a marked correspondence

between the relative development of the fungoid part of the placenta and part of the stigmatic surfaces.

I conceive that the structure of this pistillum is quite subversive of the idea of the stigma being the denuded apex of the style, for in the first place the structure of a stigma which is arranged as it were on two lines along a division of the style is fatal to such an idea, and we have an instance of the cellular growths from the margins of the carpellary leaves assuming the same appearance in both the parts removed from the influence of pressure. This is certainly the case, except in the most confined parts of the stigmatic canal where there is a tendency to fungoid growth.

A stigmatic surface arranged in two lines along the inner face of a style is compatible with the Lindleyan theory, to which indeed none but punctiform stigmata can be made applicable. An assumption of decurrence might explain it; but this is not warrantable, for it does not explain the visible line dividing off such stigmatic surfaces which is always in a direct correspondence with the ventral suture, and if the stigmatic surface originates from the apex of the style, it appears to me that the stigmatic surface would be most developed at that point: this is so far from being the case, that an additional experience of several years, including even the startling career of M. Schleiden, has but not little modified Mr. Lindley's ideas concerning the stigma. In the Key to Botany A. D. 1835,—the stigma is said to be the denuded apex of the midrib: in the Introduction to Botany A. D. 1839, it is the upper extremity of the style. But although this latter definition is less precise, and therefore less liable to error, it has not been adopted exclusively, for at page 199, the stigma is said to be the termination of the dorsal suture.

The stigma is the exposed surface portion of the conducting tissue, and as this tissue is a mere continuation of the placenta, it follows that no stigma can be really a simple organ.

In its simplest form it is due to its being reduced to a point, formed by the coalescence of two others.

No stigmata belonging to one carpellary leaf can be op-

posite, they must approach each other more nearly by the ventral than by the dorsal suture. The instances of Compositæ and Gramineæ cited by Lindley, are instances of an apparent simple ovarium combined with a plurality of styles.

In Compositæ this is proved by each having the ordinary structure, i. e. presenting the same evidence of composition, and in Gramineæ by the frequent presence of a rudimentary 3rd style.

If L. were right, no mesial line corresponding to the ventral suture will be visible, nor the stigmata of Compositæ.

From the last passage, para. 2, p. 197, the size of the conducting tissue would appear to depend upon the amount of convolution or approximation of the carpels; is this the case?

The term dorsal suture would appear to be incorrect, for it obviously points to a line of union existing in that direction.

Stigmata being the continuation of the placentæ, must have the same relations as that, consequently no stigma can be really right and left of the placenta. All the cited anomalies, Parnassia and Papaver, inexplicable by the Lindleyan hypotheses, are explicable by this.

The composition of the ovarium is indicated by the number of styles or of stigmata. Therefore, if Dr. Lindley wishes to prove his explanation of Punica to be correct, he will, as is evident from his figures of the same, concede that the component parts of the style or the number of stigmata must be equal to the number of carpels.

Whereas the number of the component parts is almost infinitely small, I believe not exceeding 5 or 6; and this number will be found to be the number of the cells of the ovarium in its very young state.

I make no account of obliteration, because the style or the stigmata are, so to say, the most permanent parts of a pistillum.

As there are many gradations in amount of parietal placentation, in some incomplete inflections of the carpellary leaves taking place, in others the ovula are borne on the face of the carpella, but in situations corresponding to the

lines of septa, it becomes a question whether such instances as Compositæ or Gramineæ are reducible to a parietal placentation or to its obverse, a central free placentation.

[—Go through parietal placentation.]

For excellent remarks on the anomalous situations of ovula, see Lindl. Introd. p. 204, para. 1. Turpin's instance of Ornithogalum is doubtful, unless he found the ovules on the veins; for I believe that in every vascular part, the ovules and buds will have direct communication with the vessels. In a Liliacea from Pushut, much like Royle's Fritillaria Thomsoniana, the connection of ovuliform buds with the leaves is most marked.

As the midrib of leaves is branched in various situations, although always least so towards its apex, it may be asked cannot a style of a simple ovary be branched? For, it is at once evident, that the style does not consist merely of the midrib; if it did, we should require instances of the midrib being branched after its production beyond the lamina. But it consists of more or less of the lamina, often perhaps of the mere margin. And if we take into consideration what would be the nature of an ovarium formed from the convolution of a divided leaf, such as a palmate leaf, we can hardly deny the possibility of the occurrence of several apparent styles belonging to a simple ovary.

It may be urged against this with every apparent truth, that such a structure is incompatible with a carpellary leaf, such leaf being a leaf in its earliest simplest form, and I need not add that all divisions in a leaf are comparatively late developments. By such an assumption I do not wish to attempt to explain such instances as Statice, Compositæ, and Gramineæ, because absolutely the existence of several styles to a simple ovary will require an amount of unilaterality of the styles, with respect to the ventral suture.

Additional proof would be afforded by the examination of the vessels, for that vessel which corresponded to the midrib would undoubtedly be the largest in a simple ovarium, and in the most extreme case imaginable the lateral ones would converge towards it at some point or another.

There is perhaps no greater proof of the composition of the ovarium than a plurality of vessels arranged in a direction of radiation from the top of the axis. Mr. Brown has well referred to this in his Memoir on Compositæ.

Orobanche indica.—It appears to me that an exception to this law is not to be found in Orobanche, although the placentæ of this genus are certainly right and left with regard to the axis, and as certainly are opposed to the lobes of the stigma.

The appearance which has given rise to the supposition of the anomaly is due to the manner in which the lines of the stigmatic surfaces become united. In Scrophularia, etc., in which the stigmatic surfaces of each placenta do not cohere with the stigmata, they have the same direction and aspect, as the carpellary leaves, viz. anterior and posterior. But in Orobanche the right stigmatic line of the upper carpellary leaf becomes incorporated with the right stigmatic line of the under carpellary leaf; the same intimate union takes place on the left side. Such union takes place in all true capitate stigmata, and the stigma of Orobanche would be capitate were it not for the divergence of the stigmatic surfaces from the apex of the style.

The true nature of Orobanche is pointed out in the mature carpel by the situation of the vascular fascicles, which are anterior and posterior, and which terminate in a clavate manner just within the sinuses of the stigmata.

For the vascular fascicle in every case when solitary occupies the axis of the carpellary leaf, and in no case does a vessel supplying the placenta become continuous to the style.

In the earliest stages it is pointed out by the fact, that the apex of the carpellary leaf is anterior and posterior, and that the sinus indicating the separation of the two leaves is in the situation subsequently occupied by the stigmata.

Or, in the earlier stages it is pointed out by the fact of the highest part or apex of the carpellary leaf being anterior and posterior, and of the sinus between the two right and left.

*

SACCOLABIUM GUTTATUM.—Pl. VIII.

Development of Orchideæ: (Vandeæ.)

A. I. 1. Floral disc and young bracteæ.
2. Disc, puncta of 3 sepals.
3. Not understood, only 2 puncta.
3a. More advanced, petals not developed.
4. More advanced.
5. Ditto, more still, labellum seen between 2 posticous sepals.
6. Vertical view, *a. a. a.* sepals, *b. b.* petals, *c.* labellum, *d.* stamen.
7. Same, sepals spread out, same references.
8. More advanced, posticous view.
9. Ditto anticous, lateral sepals a little opened.
10. Same as 8, lateral sepals spread out.
11. Same bud, anticous sepal in front deflexed.
12. Posticous view, labellum deflexed.
13. More advanced, lateral view.
14. Same, lateral sepals removed, anticous sepal spread out.
15. Same, anticous sepal in front and deflexed, lateral removed.
16. Sepals removed, petals somewhat opened; *a.* stamen, 6*b.* anticous puncta of carpel, afterwards rostellum, etc.
17. Same enlarged, one petal removed, shews that the stigmatis punctum arises below base of stamen.
18. A good deal more advanced, lateral.
19. Ditto, with bracteæ.
20. Column, labellum, and one petal.
21. Column in front, labellum deflexed, 2-lateral stigmatic puncta seen in front.
22. Column and labellum, laterally.
23. Column obliquely, 2-lateral posticous stigmatic puncta.
24. Column in front, anther removed.

25. Transverse section of the anther.
26. Apex of column, anther pushed up a little.
27. Periphery of loculus of anther, pollen a cellular mass, cells with nuclei, raphides in swarms in tissue of anther.

Results.

Original regularity of sepals.
Original homogeneous disc.
Primary development of anticous carpel punctum.

Order of Development.

Sepals.
Petals.
Stamen.

Anticous carpel punctum.

Pollinia foveolate, because the front process of anther case is incomplete. Originally the pollinia of each cell are quite confluent, original hypogynism.

Irregularity commences very early, and may be regarded as a sign of typification.

SACCOLABIUM GUTTATUM,—Pl. IX.

B. II. 1. Portion of pollen mass a little later than 27 of *pl.* 8. Cellularity more developed.
2. Some of the component parts $\frac{1}{560}$ M.* no hyaline edge, no distinct nucleus, but a grumous molecular filled bag.
3. More advanced, cells more distinct, studded hyaline edge commencing. Nucleæ as many as future grains.
4. Some of the component parts $\frac{1}{560}$ M.*
5a. 5. Rather more advanced, cells more distinct, those at the circumference are tipped with waxy granular matter, although previously quite simple.
6. Component part $\frac{1}{4}$ M.*
7. Ditto after nitric acid which renders the composition definite.

* See note, p. 7.

8. Grains $\frac{1}{550}$ M. the composition very faint, scarcely visible.
9. Under nitric acid, which shews the parent cell, and renders the composition distinct enough.
10. Bud, well advanced laterally.
11. Same, sepals removed.
12. Lateral view of the column and labellum.
13. Front view of the column, lateral stigmata very distinct.
14. Lateral ditto of the column.
15. Same anther removed, caudicula also pulled partially out of its situation.
16. Pollen grain $\frac{1}{550}$ M. composition very faint.
16. Same, after the application of iodine and nitric acid.
17. Long double section of young bud. See 18. *pl.* 8, shewing the venation of anther and anticous stigma.
18. Transverse section of the ovarium ditto.
19. Column of young bud in front, anther removed.
20. Ditto more advanced.
21. Ditto ditto.

(19–21) Intended to shew that the caudicle is not a production behind of gland, but a separation of central line of the *tooth.*

Some stages of the development are still a desiderata, but in this as in many other Orchideæ, the top of the inflorescence is generally abortive; so that unless the whole *spike* or whatever it may be, be very very young, there is an abrupt transition between the uppermost flowers to be developed, and those becoming abortive.

Results.

Simple development of pollen, the original parent cells remaining up to this time, the nuclei or granules appear to have a distinct coat.

Differs from the ordinary rule, in parent cells not opening and letting grains escape, and probably in the parent cell forming the outer tegument of the pollen.

Development in the young pollen mass, of a waxy covering to the periphery although not as in Dendrobium Dalhousianum provided with a proper coat.

Gland is the central part of original carpel punctum?
Lateral staminæ quite suppressed.
Results of (very) ulterior development.
Calcar of labellum.
Disappearance of lateral *stigmata*.

ARISTOLOCHIA LABIOSA.

There is no difference between the primary development of leaves, flower, and buds.

The flower buds are developed later than the axillary buds, on extremely short branches; and the first developed part is the leaf at the back of the axil which is opposed to the flower bud, and subsequently nearly encloses it.

Then the axis.

Then below at first an entire gibbosity, denoting the situation of the flower bud.

As this developes, it is enlarged; it then appears truncated at the apex, with very obsolete appearances of 3 puncta; then in the next stage the margin immediately opposed to the *leaf*, is produced obliquely, the two other puncta scarcely apparent, although the apex of the bud is evidently concave. It remains in this state for some time, appearing oblique at the apex with a slit-like concavity or fissure.

The other bud at the same time goes on increasing, presenting alternate teeth or projections from the disc, which are leaves; it does not appear to arrive at any great development.

The flower bud goes on obliquely elongating, presenting the same slit-like fissure, and the tube gradually becomes developed.

The next part developed appears to be the cavity of the ovarium and the stigmata, which are 6 truncate bodies tapering below into parietal placentæ. The perianth when this happens is curved, and proboscis-like, the fissure presenting two curves, but there is no production of the smaller proboscis.

A bud was in one instance formed between it and its axillary leaf (!)

Even when the second smaller proboscis has commenced, there are no rudiments of stamina, the tube of ovarium is occupied by 6 fleshy grumo-cellular projections, terminating above in 6 distinct, oblong, truncate bodies, between each projection is a vascular fascicle.

Now in this instance, what parts of the perianth are the sepals?

Or, as the first appearances of the young bud are much like those of young carpel leaves, is the perianth a metamorphosed leaf, or is it compound? The proboscis first formed is opposed to, or next the axillary leaf, it subsequently becomes the labium; whatever its shape is, judging from its punctum, *it is an entire leaf;* then where are the lateral sepals?

ARISTOLOCHIA LABIOSA.—Pl. x.

A. 1. Axillary bodies, leaf removed; *a.* flower bud, *b.* dorsal leaf, *c.* a bud consisting of a leaf, placed back on the flower bud, and *d.* disc.

2. The same, dorsal leaf removed *shewing* its bud.
3. Front view of flower bud.
4. Long section of ditto.
5. Bud of dorsal leaf, *detached,* now a tube to perianth and ovarium.

B. 1. Mode of suffulting, leaf removed. Flower bud and dorsal leaf removed.

2. Flower bud in front.
3. Seen obliquely.
4. Laterally, at the base is seen an additional bud.
5. Apex of tube of ovarium or base of tube of perianth shewing the 6 stigmata.
6. Bud, additional in front.

C. 1. Flower bud and the dorsal leaf.

2. Flower bud laterally.
3. Ditto in front.
5. Apex of ovarium, perianth removed.
5. The same.
6. The same spread out to shew the vascular bundles alternate with the stigmata.

D. Shews all the parts formed, intermediate stages not yet observed ; shews that the anthers are opposite to and adnate with the stigma lobes, but still from these alternating with the costæ which represent the carpel leaves, that they are compound by adhesion, i. e. actually the stigma of each carpel alternates with the stamens.

A. Transverse section of part of the ovarium shewing the vascular fasc. and placentary productions, no trace of ovula yet.

ARISTOLOCHIA LABIOSA,—Pl. II.

A. 1. Summit of axis, *a. a. a.* scars of young leaves removed, *b.* lowermost axillary bodies, *c.* future flower, *d.* dorsal leaf of bud, *e.* summit of its axis. The opposite side of the fig. represents the next axillary bodies, *f.* being the axis, *g.* the dorsal leaf.

At *h.* is the third axill. now reduced to an entire disc, no trace of its leaf, no trace of flower bud. In the axilla of the leaf, *i.* there is no disc.

Then comes the discoid summit *k.* and a leaf just forming *l.*

2. Axillary productions, more advanced *scar of petiole.* *b.* flower bud, *c.* axillary bud, with its dorsal leaf, *d.* the same dorsal leaf in front separating the disc, on the front of which is the punctum of another leaf, *e.* flower bud, oblong rounded, with perhaps rudiments of three puncta, *f.* the same.

3. 1. Portion of a stem at a node, leaf removed, then comes the flower bud. Then the axillary productions, i. e. dorsal leaf and disc.

2. Flower bud and axillary leaf removed, the dorsal leaf is cut away.

3. The same, part of axillary production in front, shewing the truncate entire disc.

4. 4. Flowers in front, appearances of three puncta, terminal oblique one most developed, no tube or cavity, but merely a depression.

4. A. Portion of a young axis, shewing venation of the leaves.
B. The axillary productions of the lower leaf of the above, leaf itself removed, *a.* flower bud, *b.* dorsal leaf.
C. The same dorsal leaf deflexed.
D. Flower bud in front, no tube, but concavity now deeper.

5. 1. Apex of ovarium laterally.
2. Vertically.
3. One body removed.

6. 1. Flower bud.
2. Ovarium and genitalia, posticous ones most developed.
3. Stigmatic lobe and stamen, viewed in inner surface.
4. A body laterally, no stigmatic lobe (?)
5. Another body laterally, inner tooth represents the stigmatic lobe.

It is difficult to be sure which appears first, stamina or stigmatic lobes, but analogy is in favour of its being stamina, and the appearances also.

7. 1. Ovarium and genitalia.
2. Same vertically.
3. Stamen and stigmatic lobe, laterally.

It is legitimate to assume that the stigmatic lobes are latest developed.

This altogether is a remarkable instance. In the first place the puncta generally or distinct are altogether obscure, it would be impossible to say whether the perianth is formed from 1 leaf or 3.

Then the absence of puncta to the ovarium, i. e. if the lobes that first appear are stamina, is remarkable, and if they are stigmata, then the later development of an outer verticellus is also remarkable. If the perianth is assumed as 3 sepalous, the alternation is regular.

Sepals.
Stamina.
Stamina.
Carpella.
Carpella.

FRUIT OF ROXBURGHIA.

Fructus semi-maturus lanceolato ovatus, lateraliter compressus, basi perianthii semi-marcescenti stipatus, obtusus, suturis lateralibus 2, parum profundis, 1-locularis, multi-ovulatus.

Endocarpium album rugosum, membranaceo-cellulosum; ovula 00, basi loculi affixa; funiculis longissimis medium paulo supra incrassatis, partibus incrassatis undique pilis cellulosis pulcherrimis, supra infraque directis, tectis: ovulis, subcylindricis, lineis 2-longis, rostratis, striis multis longitudinalibus subrepandis notatis.

Pilis funiculi cellulosis, plus minus sinuatis, cavis, vel tubulosis (tubi parietibus cellulis oblongis, irregularibus, laxis efformatis) aer copiose continentibus.

Tegumento unico, celluloso, albumini adnato sed dissectione separabile, extus pluri costato, costis basin seminis versus magis elevatis. Raphe in fasciculis 3-4-divisa.

Albumine copioso, carnoso, semini conformi; embryone in cavitate, ad basin albuminis fere locatâ, sito, minuto, subclaviformi, nempe inferius crassiore, ibidemque breve apiculato, hinc basin versus rimâ brevi longitud. notato Plumulis parvis in rima nidulantibus. Radiculis crassis obtusissimis inferis. Cotyledone tereti, conico-subulato.

Chalazæ loco *calloso* luteo-brunnescenti, rostri basi opposito.

The cavity containing the embryo extends some distance towards the apex (?) of the seed.

It is I think lined with vitellus or (quartine aliorum,) the membrane being united firmly to the albumen. I judge so at least from the shining appearance of the walls of the cavity. The sphacelated apex of the nucleus, in which or rather the quartine, the albumen appears to be developed, is visible at the base of the seed and somewhat laterally.

The funicles of the innermost ovula are by far the largest. They are all cellular, most so towards the base where like-

wise they are thickest, with a very large central vascular fasciculus containing ducts and spiral vessels; these last perhaps exist only towards the base, as they are here *only* freely unrollable; the tegument consists of 3 layers, the inner of which is cellular and very lax, the cells being disposed transversely. The inner layer is with difficulty separable, and like the outer very fine. Occasionally there is a cleft extending along the dorsum of the seed, but it does not penetrate the inner portion of the tegument. Both the apex and base of the nucleary membrane are subsequently free.

Plate 62, Fig. II. Fruit of Roxburghia.

1. Seed.
2. Ditto, long section.
3. Albumen separated, with its basilar cavity.

4, 5. Embryo.

6. Ditto, long section shewing the sub-exsertion of the apex of the plumule.

Professor Lindley's description and figure, Wall. pl. Asiat. Rarior. Vol. 3, tab. 282, p. 49, is correct excepting the "funiculus apex arilliferus," and "plumula rima nulla." Hence, according to this distinguished author, it differs chiefly from Aroideæ in its highly developed perianthium.

June 11th, 1835. Calcutta, H. B. C.

From the enclosed *observations*, as represented in the sketches, it follows that Roxburghia is unicarpellary, and hence more Aroideous than Dioscoreous.

That the placenta is not marginal, and not central, but forms an elevated margin parallel to the convolution of the base of the carpel leaf. That nevertheless it is double, to whatever it be referred.

That the carpel leaf is a convex body, open near the centre; that the ventral suture by the production of which it becomes a convolute leaf, is a subsequent extension downwards of one margin of the opening.

That it is unicarpellary, not only from development, but from obliquity of the stigma.

That the stigma as the outer communication of the conducting tissue, cannot be shewn to be continuous with the placentæ.

That the fœtid smell is the last part developed, the colour the penultimate.

That the stamenal cohesion is a subsequent development.

That the processes are due first and largest to the connection of elongation, the second to an elongation and connivence of the upper part of the loculi, which subsequently become effete.

That the perianth is quaternary two and two.

The stamina quaternary two and two.

That they are genuine stamina *totally*, not by any means adnate to any other organ, as Endlicher would have it.

That the placentæ are not alternate with the sutural lines.

That parietal placentæ in all cases run longitudinally as regards the carpel leaf, that here they are round its base !

That there is a slit for the emission of the plumula.

That the sum of the characters is nearer Aroideæ, than any others.

ROXBURGHIA VIRIDIFLORA.—Pl. XII.

1. Long, double section across, short diameter of pistillum shewing the placentary ovule lines to be double.
2. The same, at a much earlier period.
3. Pistillum, young.
3*a*. The same, margins bent back a little.
3*b*. The same, torn back.
4. Younger pistillum, lateral view.
4*a*. Same, vertically seen.
4*b*. Placenta of ditto.
4*c*. Vertical view of the placenta, the ventral line drawn too distinct.
5. Very young pistillum, ventral suture only commencing.
6. Ditto rather more advanced, lateral view.
6*b*. The same, vertically, seen.
7. Another, vertically, do.
7*c*. Placenta, vertically, do.

8. Another, vertically seen.
8*c*. The placenta of the same, vertically seen.

The sequence is—

5.
6. 6*b*.
4. 4*a*. 4*b*. 4*c*.
8. 8*c*.
7. 7*c*.
3. 3*a*. 3*b*.
2.
1.

Results.

That it is impossible to refer the placenta to the margins of the carpel leaf, although they evidently are double organs, and are double when the ventral suture is completed. Yet at the first the placenta is nothing but the *disc* terminating the axis, although flattened.

That no part appears traceable to the margins, not even that close to the ventral suture.

The pedicels very early *appear* articulated, the annulus being of early development.

ROXBURGHIA VIRIDIFLORA,—Pl. XIII.

A. 1. 1. 1. 1*a*. Pollen grains, soon after their exit from parent cell, $\frac{1}{16}$ M., 1 *a*. is an instance simulating quaternary division, probably due to mucilaginous or oleaginous globules.
2. Long section of pistillum.
3. Ovulum.

B. 1. Length of flower bud.
2. Pistillum.
3. Ditto, dorsal face.
4. Long section.
5. Ovulum.
6. Transverse of stamen.
7. Pollen grains, nearly mature, but outer coat not so discernible as subsequently.

C. Expansion.

1. Pistillum.
2. Ditto ventral face.
3. Ditto vertically, no clear distinction now between the two sutures, but the dorsal one is brownish, and broader than the other.
4. Long section.
5. Ovulum.
6. Ditto, under pressure.
7. Pollen grains in oil, $\frac{1}{16}$.

7*a*. Ditto opaque objects, $\frac{1}{4}$.

8. Pollen grain, iodined, $\frac{1}{16}$.
9. Pollen grain, dehiscing, $\frac{1}{16}$. } Nitric acid.
10. Ditto intine escaped, $\frac{1}{16}$. } Nitric acid.

Results.

Imitation of dicarpellary by uni-carpellary structure.

ROXBURGHIA VIRIDIFLORA.—*(Continued.)* Pl. XIV.

A. 1. 1. 1. 1. Represents the development of the young parts of the axis. The young leaves are opposite, bearing a disc in their axillæ, which disc is quite entire, presenting no puncta.

A. 2. Represents summit of axis, with a disc almost enclosed in the two last leaves.

3. Represents the disc with the two leaves spread out, it is seen to present two puncta of two additional leaves.

4. Same disc, ultimate leaves removed.

4*a*. Same, viewed vertically.

B. 1. Represents a very young flower, but always known by presenting a leaf nearly opposed to the suffulting one.

2. Somewhat more magnified ; *a.* punctum of inner sepals just visible.

3. Same, leaf removed.

C. 1. Portion of an axis, with two opposite leaves, each

with an axillary bud. This bud always consists of a terminal bud, and a lateral later one in the axil of the alternating leaf.

2. Bud detached, *a.* alternating leaf, *b.* terminal bud, much more advanced.

3. 3. Axillary bud of alternating leaf *a.* detached exceedingly rudimentary.

D. 1. The same more advanced, *a.* alternating leaf, *b.* terminal bud.

2. Same, opposite side, and alternating leaf removed, shewing its axillary bud, with a sub-opposite (!) bract.

3. Axillary bud removed, *a.* bract, *b.* outer sepals, *c.* inner ditto.

4. 4. Two vertical views of the same. Perianth slightly opened, shewing the puncta of the stamina.

E. More developed.

1. Lateral view, *a.* alternating leaf, *b.* terminal flower bud.

2. Same, alternating leaf for the greater part removed, with the terminal flower bud, exposing the axillary bud.

3. Axillary bud of leaf *a.* detached, composed of terminal *a.* and lateral No. 4.

4. *Budlet*, from axillary of bract of No. 3.

5. Terminal bud, one outer sepal removed.

6. Same, two inner sepals bent back, shewing the stamina.

7. Vertical view of staminal insertion.

8. Same, stamina somewhat *opened out.*

Results.

Original homogeneousness of parts. Development of floral envelopes, and male organs from puncta on a cellular, or mucilagino-cellular disc. Development of the envelopes and other parts in series, the last appearing being the central or pistillum.

ROXBURGHIA VIRIDIFLORA.—(*Continued.*) Pl. XV.

A. Lateral and terminal buds of the same branch.
1. Lateral bud, in axilla of alternating leaf *a*.
2. Same detached, *a*, *bract* which again may produce a bud in its axilla.
3. Bud of the same, staminal puncta developed.
4. Terminal flower bud of the same; perianth, excepting one inner sepal removed.
5. 6. Stamina of the same, they having assumed the mature form.
7. Pistillum, a disc, perforated at the apex, perforation sub-central, fundus occupied by a disc.

B. Terminal flower bud.
1. 3. Sepals removed.
2. Same, stamens spread out to shew the pistillum.
3. Dorsal view of a stamen, as transparent object shewing the opacity of the connectif, and the transparent grumous appearance of *cells*.
4. Same in front, 4 *a*. contents of the cellular portion, scarcely separable.
5. Pistillum, perforation or opening extended down one side! Inner disc unaltered.

C. 1. Terminal flower bud, the two outer sepals removed.
2. Same, all the sepals removed.
3. 4. Stamina.
5. Transverse section of ditto.
6. One locellus, cut transversely.
7. Contents of locellus, scarcely separable grume, with rudiments of nucleary cells.
8. Vertical view of the pistillum, now with a distinct ventral suture at *a*.
9. Another view, opening smaller in size.
10. Pistillum half of, *a*. opening, *b*. dorsum, *c*. ventral suture, *d*. placentiform free placenta!

11. Vertical view of placenta, tending to be divided opposite to the ventral suture. See *a*.

Results.

1. Process of connectif and of apex of the cells of the anthers, a result of ulterior development.
2. Formation of the parent cells of pollen grains in a grumous mass, filling the locellus of anthers, and scarcely separable from it.
3. Formation of the ventral suture by a carrying down of one side of a central opening!
4. Development of placentæ even at a very early period, independently of any inflection of ventral suture!

ROXBURGHIA VIRIDIFLORA.—(*Continued.*) Pl. XVI.

A. 1. Transverse section of anther.
2. Separable mass of locelli of same, $\frac{1}{4}$. M.
3. Nucleary young parent cells, $\frac{1}{4}$.
4. Same, $\frac{1}{16}$.

B. 1. Stamen.
2. Portion of the contents of the locellus, now easily separable, $\frac{1}{4}$.
3. Parent cells, $\frac{1}{16}$.
4. Do. one after nitric acid, $\frac{1}{16}$.
4. *a*. Ditto ditto, and iodine, $\frac{1}{16}$.
5. Pistillum.
6. Ventral face.
7. Dorsal face, now presenting a broad suture.
8. Long central section of the same.
9. Vertical section of placentæ.
10. 11. 12. Ovula.

C. 1. Transverse section of the anther; the parent grains are now separating in the fluid under the field of the microscope.

2. 2. Parent grains, $\frac{1}{16}$ M.
3. 4. Do. do. after nitric acid and iodine.
5. Parent cell, young pollen grain making its escape.
6. Young pollen grain.
7. 8. Ovula.

Results.

The late development of the stigmatic surface.

Ditto ditto dorsal suture. Want of connection between placentæ and margin of carpel leaf.

Development of the parent cells, in masses subsequently confluent, and enclosed in an *inorganic* looking muco-mucilaginous substance.

Enlargement of these; disappearance of nuclei (cytoblasts); appearance of a hyaline envelope, containing a grumo-molecular nucleus, (without cytoblast). Division of this nucleus into, 2 3, 4 parts. Separation of these.

Development of the inner tegumen of the ovulum first.!

AMHERSTIA NOBILIS.—*Evolutio Florum.* Pl. XVII.

A. 1. Apex of the axis of a young raceme, nothing in the axillæ of the tender cellular scale-like bracteæ.
2. The same, two of the outermost more developed bractea removed.
3. The same, viewed vertically, a punctum only of an inner or 6th bractea seen. Remarkable similarity to floral disc.
4. Bractea and its axillary disc, which is now simple, not even the lobes or puncta or bractlets present.
5. Axillary disc, with one bracteole beginning, and another chalked out.
6. Same, further developed.
7. Ditto ditto ditto.
8. Its disc, viewed vertically.
9. Bractea and bud.

10. Bud of the same.
11. Floral disc ditto, of rudiments of the 5th or anticous sepal.
12. Another disc of the same period; *a.* anticous sepal.
13. Bud, more developed.
14. Floral disc, with outlines of the 5th sepals.
15. Vertical view of ditto.

Results.

Extraordinary *homogeneousness* between the origin of all the parts, viz., axis, bracts, bracteoles, and sepals.

Bracteoles not opposite, because one is developed first.

5. Sepal, outermost developed first.

Extraordinary similarity between the appearance of the disc, when producing bracteoles (or sepals) to an ovulum in its earlier periods.

PLATE XVII.—(*Continued.*)

B. 16. Very young flower, now consisting of 5 outlined sepals, gibbosities, and a central simple angular disc.
17. The same seen vertically.
18. Another seen laterally, rather more advanced.
19. Same seen vertically, between the sepals and the puncta of the petals.
20. A little more advanced *vertically.*
21. Same, sepals spread out, shewing the disc and the puncta of the petals.
22. A bud, more advanced; 5th sepal bent down. Punctula of the outer stamens! between the puncta of petals and centre of the disc.
22*a.* *Bud,* 22*b.* Ditto, bracteoles removed.
23. The same more advanced, all the parts, except the inner row of stamina, chalked out.
24. Earlier sepals spread out, no furrow visible on the surface of the cone or centre of the disc or pistillum.
25. More advanced, bud, with base of its bracteæ.
26. Bracteoles removed, anticous 5th sepal in front.

27. Same, anticous sepal in rear.
28. Ditto, laterally.
29. Sepals spread out, all the puncta, and even furrow of the conduplication of the pistillum visible, but no inner series of stamina.
30. The same, two posticous sepals bent back.
31. More advanced bud, seen anticously.
32. Ditto ditto, laterally.
33. Sepal reflexed. Petals in front removed, and also outer front stamina; shews the inner series of puncta.
34. Sepal and petal detached.
35. Stamen.
36. Pistillum, seen ventrally.
37. Ditto, $\frac{1}{10}$ M.

Results.

That the pistillum is at first a projection with a smooth surface: that it then becomes depressed along its posticous face.

So the convolution appears subsequently! and is not an absolute primary process.

The inner row of stamina makes its appearance long after the punctæ of the other parts of ditto.

That the tube of the calyx is a late development.

That the sepal and petals are *ab initio*, regular.

AMHERSTIA NOBILIS.—(*Continued.*) Pl. XVIII.

1. Bud, sepals reflexed, two outer stamina removed, shewing the origin of the second row.
3. Same, more developed, sepals slightly separated.
3*a*. Ditto, vexillum bent down.
3*b*. Ditto, sepals reflexed, 2 stamina, outer series removed.
2. Bud, sepals in situ, as seen from the vexillar face.
2*a*. The same, viewed laterally.
2*b*. Same, sepals reflexed, viz. 1 lateral, 1 smaller anticous.

2c. Stamen, front view.
2e. Ditto, lateral.
2f. Ditto, back.
2g. One of the inner stamina.
2h. Pistillum, as seen from the ventral face.
4. Stamen in front, rather more advanced than *2c.*
4a. Its grume now separable, but not cellular even under $\frac{1}{16}$ C. N.

Development of Pollen.

5. Parent cells, $\frac{1}{4}$ M.
5a. Same detached, $\frac{1}{16}$.
6. Parent cells, still adhering: nucleus of 5, now divided into 3 or 4, each with a nucleus, and rudiments of one tegument, $\frac{1}{4}$.
7. Parent cells, now easily separable or even separating $\frac{1}{4}$.
7a. Young pollen grain, escaped, $\frac{1}{16}$.
8. Young pollen grains, $\frac{1}{16}$.
9. More advanced, (surface in focus.)
9a. Same, centre in focus.
10. Perfect pollen grain, $\frac{1}{16}$.

Sequence.

1st. Grume.
2nd. Grume and traces of cells.
3rd. Cellular cohering, cells: nucleary nucleus, like a *globule* of fusion.
4th. Divisions of nuclei.
5th. Formation of each into a contained pollen grain, disappearance of nuclei.
6th. Liberation of the young pollen grains.
7th. Development of grume and cellular membrane: outlining of the folds or furrows.
8th. Striæ of the outer coat.

N. B. [*Capital letters* refer to sequence of period.]

AMHERSTIA NOBILIS.—(*Continued,*) Pl. XIX.

1. Young bud, bracteæ removed laterally.

2. Young bud, opposite face.
3. Calyx removed, vexillar face.
4. Same, larger petals or alæ removed.
5. Same, vexillar face, alæ removed.
6. Bud, calyx only removed, anti-vexillar face.
7. Alæ removed, vexillum deflexed; two stamens also bent down.
8. Vexillar face, vexillum reflexed.
9. Tube laid open, alæ removed.
10. Transverse sections of anther.
11. Contents of its cells.
12. Long section of ovarium. Pistillum.
13. Ovulum.
14. Transverse double section of ovarium, shewing the marginal origin of ovulum.

CALOTROPIS PROCERA.

In the perfect flower of Calotropis, the stigmatic tissue is highly developed: in the style will be found the shape of lax irregular cells, generally oblong, containing greenish globules.

At the point where the union of the styles begins, the outer parts of the conducting tissue, except on the immediate dorsum, will be found of a pinkish tint: a transverse section presents four oblong pink spots, a central perforation, for the styles are not united throughout their applied surfaces, and a dorsal vessel.

These pink spots diverge outwards, gradually increasing in extent, at length coalescing and surrounding the whole stigmatic disk.

The stigmatic surface and its immediate relation with the fissures is well seen on a transverse section.

Along its section shews that the pink tissue passes into the style at the spot of articulation.

No change has taken place in the pollen masses, except that the crura of the glands are no longer elastic, and have acquired a more brown tint.

The structure of the anther is essentially the same, but the grains contain more granular matter which, with the *oil* spots, forms a conformable nucleus.

The ovula are now helmet-shaped, the groove is of large size; they are quite cellular and solid, although the turgidity of the superficial cells towards their geometrical apices to the centre, leads me to suspect that the cavity of the embryonary sac is about to develop; the part which would correspond to the apex of the nucleus is grumous fuscescent. How invariably new tissue that is to be, is of this colour by transmitted light.

The leaf consists of a cutis, on either side is a central stratum of vessels, and on either side of this a green parenchyma; of this the upper (or posterior) is much the most dense; it is at right angles with the vascular strata, and from a peculiar arrangement of the green matter, appears to be traversed by close parallel horizontal lines of dark green: the under stratum is somewhat cavernous, almost twice as thick as the upper, and is likewise at right angles with the vascular stratum, at least near the cutis; near the vessels it is more irregular and cavernous. I do not believe these are strata of vessels; it appears decidedly one envelope, as always seems to be the case in fibrous tissue.

With the green matter which is amorphous under 1-20th, there occur large grains of greenish tints, often solitary, generally so perhaps in the upper stratum; they have the peculiar rotatory motion.

Although the inner margin of the pollen mass, undoubtedly appears thickest, yet this is more apparent than real, and perhaps is owing to the two side margins being more approximate here than elsewhere; when spread open it is found to have an uniform structure.

Those pollen grains are first acted upon by reagents that are near the place whence the *boyaux* issue; acids and iodine cause an appreciable action by rendering opaque the granular contents of the pollen grains, which in the ordinary state appears to be quite transparent! the mass having the appearance of a yellow flat piece of wax with cellular sub-divisions.

Directly the membrane is torn across even water causes the opacity to be evident.

In the petals, there are two strata of tissue, but no decided cutis; the outer is most cavernous, corresponding to the under side of the leaf: hence Schleiden's idea is worth following up; the inner however is irregularly cavernous like the other stratum, but not to an extent in proportion to their respective thickness.

Oil renders it very transparent, it then appears like a cellular mass, with a continuously uniform edge; it developes a slight grumous appearance through the membranous to the cellular part, then the cells near the bulbous part get more and more opaque. The membrane is evidently thicker in the neck on both sides than elsewhere.

The under face of the mature stigma presents very marked appearances, the styles above the articulation have a spongy cellular look; while as it expands into the disc, it assumes a pink colour.

The disc itself is pink and striated, except the concave faces between the angles, which correspond with the finer faces of the anthers: the line of demarcation between these is semi-circular, and has a somewhat ragged look; the concave spaces are green, and have not so stigmatic an appearance even as their upper margin; the ends of the angles are slightly fuscescent.

The stigmatic surface is still visible on a transverse section, although obscured by opaque grume, and mucilaginous looking cellular bodies. [In the development of this plant the first anomaly that occurs is the consolidation of the two apices of the pistillum into an imperforate disc. This is followed by the articulation of this disc on the style, although it may appear foreign to sound philosophy to attribute all the subsequent peculiar organizations to this, as a direct cause. Yet it certainly may be made to afford a satisfactory explanation of the phenomena as they exist.*]

* Evidently intended by the author to be superseded by what immediately follows.

The closure of the stigmatic canal can only determine the situation of the stigmata surfaces.

In the development of this plant the first anomaly that takes place is the consolidation of the ends of the pistillum, and the consequent closure of the usual, and perhaps elsewhere, invariable channel of fecundation.

This may be considered, perhaps, as necessitating some degree of separation between the disc of the so-called stigma and the body of the pistillum, in order to allow external communication with the conducting canal.

Is there any relation between the hardness of the sides of the fissures, and of the *pollinia?* It seems reasonable, that when these are hard they require hard surfaces to enable them to be interposed.

The glands are a mere secretion from the furrow of the angles, the secretion commences along the outer angles of each furrow, where it proceeds inwards until it occupies the whole surface of the furrow.

A transverse section of the gland will therefore (as the matter is nearly equally secreted, and the inner edges of the margins, certainly not walls,) present the same figure in a considerable measure as that of the furrow itself.

Fecundation appears to be of uncommon occurrence in this genus, and indeed the obstacles opposed to it are very considerable. For independent of the general obstacle, as it would appear to be, of the passage of the *boyaux* through a determinate spot, the sides of the fissures are closely approximated, and possess so much hardness as to require a considerable degree of force to open them. Corresponding with this narrowness of the fissure is the compressed state of the *grain*, and perhaps its hardness.

Comparison between Asclepiadeæ and Orchideæ, (?) in both the amount of solidity of pollen, determines the presence of a gland? Query, are the obstacles greatest in Asclepiadeæ?

The calyx appears to originate in the same way. I find that a branch of the inflorescence in its earliest stage consists of two cellular bracts, with a convex protuberance, in the axil: the terminal flower is a turbinate cellular mass, with

very slight indications of five future divisions, with a rather elevated centre.

A curious resemblance to antitropous ovula may certainly be pointed out. That which is to be the petal, corresponding to the nucleus; the way the sepals are marked out is much like the way in which the *tegumentum primum* is marked out. Pressure in both destroys the markings, reducing the whole body to a homogeneous mass.

The monopetalism is detectable at a very early period, so early that it is doubtful to me whether the divisions ever reach *the base*—when the pistillum does not exist, and the anthers are mere lobes of the disc, the divisions of the corolla do not reach to the plane of the base of the calyx.

Calotropis procera.—In the earliest stage the calyx exists in the form of 5 unequal sepals; it is lodged in the axilla of a lanceolar subulate-ending bract. Pl. 20. (—A.) fig. 1.

The centre of the calyx, which is connivent, is occupied by a disc of large size and considerable protuberance. A little later, and this disc will be found to present obscure appearances of becoming 5-lobed, and still a little later, and it is 5-lobed (or divided into 5 PETALS) corresponding in situation to the petals. Pl. 20. (—A.) 2.

In the next stage I observed an additional 5-lobed body inside that of the corolla, no ovary. Bracts even cellular.

The stamina are marked out by a process of a similar nature, they exist at first as a disc, then this disc becomes 5-lobed, the lobes then become separated into 5 bodies, which subsequently become stamina. The pistillum up to this period can scarcely be said to exist, but when the stamina are marked out, it may be found occupying the axis in the shape of a depression, with a slightly elevated margin, the margin presenting appearances of division into two.

The calyx has now one vein terminating about $\frac{1}{3}$ from its apex, with a tendency to ramify about its middle. Vide, Pl. 21. (—B.) 1. 2.

When the flower bud is one line long, the calyx is tolerably developed, and encloses entirely the parts of the flower. The corolla now consists of 5 cellular oblong concavish bo-

dies, perfectly hypogynous, perfectly distinct. Vide, Pl. 20. (—A.) *3. 3a. 3b. 3c. 3d.*

The stamina still have a glandular appearance, the pistillum exists as two truncate scales, concave internally with thickened margins, the two together forming a sort of cup. Vide, Pl. 20. (—A.) *5. 5a. 5b. 5c. 5d.*

The next stage presents the petals more developed, but still only slightly united, with some inequality of apex. The stamina have now assumed almost precisely the appearance the petals had previously. The scales composing the pistillum have increased in size, and slight traces of the ovarium itself are discernible. How is this formed?

The next change affects the slight union of the petals, the first step to the formation of a gamopetalous or monopetalous corolla. The stamina consist almost entirely of the anthers, and occupy with regard to the stigma pretty much the position they subsequently keep. They will be found to present traces of emargination, and of the two cells, being subsequently occupied by the pollen masses, but there is no separation of structure. Vide, Pl. 20. (—A.) 6. *6b.*—Pl. 24. (—E.) 14.

The pistillum now exists as two minute ovaria, each provided with a very short style terminated by a large disc, which disc has originated in the union of the two scales before described. This head or stigma is even at this period imperforate or nearly so, and may be observed to be articulated with the style.

The next stage presents a greater degree of monopetalism, and *a* colouring of the interior of the corolla. The anthers are more emarginate, the apex bent over the disc of the stigma. Pl. 20. (—A.) *7. 7a. 7b. 7c. 7d. 7e. 7f. 7g. 7h.*

The sides are beginning to assume their curious structure. The traced out cells contain in the centre of their cellular body a grumous amorphous mass, in which $\frac{1}{20}$ scarcely detects any granular matter. Pl. 24. (—E.) 12. *12a.* 13.—Pl. 22. (—C.) 12. 13. 14.

The pistillum has undergone little change except in the size of the ovaria, there are at this present indications of

involuted margins, producing large placentæ; no trace of ovula are distinguishable.

The filaments or *corona staminea* next begin to be developed, the processes at this time existing in the form of two elevated oblong gibbosities, one on either side of the central line of the anther, and becoming above continuous with the base of this. They also have contracted adhesion between each other, a triangular space with thickened sides remaining in the upper half, but not admitting a view of the ovary. Pl. 22. (—C.) 1. 2. 3. 4. 5. 6. 7. 8. 9.—Pl. 24. (—E.) 1. 2. 3. 4.

The anthers have almost their mature form, but not consistence. The margin of the anthers from the lower part of the angle passes in towards the processes leaving between them a triangular space, the lower margin of which has a thickened growth. The cells are very distinct, and will be found to contain a mass by which they are rendered turgid, which escapes readily, and consists entirely of an aggregation of large and minute granular matters, held together in some inappreciable manner. Still earlier and the whole contents are mere grumous, in which $\frac{1}{20}$ detects few granules; when the cell is so filled, the membrane of the same may be detected lining the cell, and adhering to its walls.

It becomes much more pronounced when the aggregation and segregation of the granules takes place.

The ovaria have undergone no particular change, the furrows of the stigmatic angles now present traces of the glands in the form of two linear adhering bodies, like coagulated mucus, darkish brown along the inner $\frac{2}{3}$, whitish along the outer margin. The stigma will be found to have, as indeed at the former period, a *lisse* aspect except its upper surface, which has a cellular one. A transverse section shews, that the whole of its sides and surfaces except the upper, is occupied by stigmatic, tissue, equally distributed, but ceasing gradually towards the site of the articulation, which is complete.

The placenta presents no traces of the development of ovula.

The next stage presents the coronal processes, gibbous and closed at the bottom, but not recurved.

The contents of the cell of the anther have undergone a remarkable change, for the granular matter has become grouped into massules, and all are contained in a positive membranous sac, like coagulated mucus, of a fuscous tint, and which is easily separable, but most lacerable.

Pl. 21. (—B.) 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. etc.

Pl. 22. (—C.) 10. 11.

Pl. 23. (—D.) 11. 12. 13. 14.

The glands have become incorporated along the inner margin, preserving however an emargination of both ends and a centre groove, traits of their original distinctness.

The circumference of the placenta is occupied by roundish cellular simple bodies, the young ovula.

When the calyx is just expanding, the corolla is highly coloured inside, nearly equal to the calyx.

Anther closely applied to faces of stigma.

The massules then begin to present the appearance of being contained in a cell of fuscous yellow tint.

When the massules are a little more advanced, they are held together by extremely delicate filamentous tissue, not exactly appreciable by $\frac{1}{20}$. After the mass of massules has escaped, the sac appears lined with amorphous grumous tissue, just like that which is contained in the cell at an earlier period.

As transparent objects, in the earlier stages of the existence of pollen grains they are indistinct, and the whole sac appears filled with grumous granules, but they are easily detected on dissection.

When the recurvation of the processes of the *corona staminea* has begun, the filaments will be found completely united, the triangular space under the sinuses of the contiguous margins of the anthers having become filled up, the sides become indurated. Pl. 23. (—D.) 1. 2. 3. 4. 5. 6. 6. 7. 8. 9.

The membrane contained in the cells continues very distinct, still fuscous, each sac contains a quantity of simple cells, containing granules of unequal sizes: these are the pollen grains.

The stigmatic surfaces are the same, the lands are per-

fectly formed, but their *crura* do not cohere with the pollinia. The ovules have not undergone curvation, they have a short stalk, but a furrow or groove is detectable along the upper edge.

When the corolla is three lines long, the corona is nearly perfect, its upper edges tinged with pink, and reaching a little above the base of the anther. All the parts have received their development, but no union has taken place between the pollinia and glands. Vide Pl. 25. (—F.) 1. 2. 3. etc.

The pollinia consist of a yellow closed sac with an uniform structure and consistence; it contains a mass of simple cells, containing a nucleus of granules, and 1 to 5 transparent bubbles (of oil ?) this mass is only slightly coherent: its component cells which are the pollen grains are easily separable, no traces of cellularity visible in the membrane of the sac when it is freed from the grains.

When the inversion of the ovula is nearly ⅓ complete, the groove is very distinct.

No other change of any importance takes place, besides the union of the glands and the pollinia; the neck of these first appear through the apex of the cell, and then the union takes place: the crura of the glands are highly elastic at this time. Vide Pl. 25.(—F.) 5. 5*a*, 5*b*.

The union soon becomes most firm, so much so that the pollen grain rather tears across than gives way from the gland.

The perfect flower presents precisely the same structures, only enlarged. The processes of the corona are now secreting the inner surface, especially towards the fundus; they are separate throughout their length, except at the apex of the incurved spur.

The perfect pollen mass is a yellow quite transparent wavy object, with an entire membranous edge, and an apparently cellularly sub-divided superficies. [This transparency or invisibility of the amylaceous or proper granules, appears to me curious, and is worthy of more close examination; generally water has no such particular action, indeed its action may be stated to be in some measure the reverse, since it renders such objects more transparent.]

Its structure is at this time obviously as I have represented it. The membrane is uniform throughout, except at the neck where it appears to be thickest, along the inner edge there is an apparent thickening; but this depends on the sac being more pressed together at that point; it disappears on spreading the sac out flat.

The mass is of a corneo-waxy consistence; water after sometime causes the cellular part to become minutely granular, the opacity commencing nearest the future line of dehiscence: iodine acts slowly upon the contents of the grains, and never produces any vivid tint; oil renders them quite transparent at first, then like water develops a granularity. The grains of themselves in water appear as a hyaline cell, of irregular, often angular shape, with a nucleus of opaque granular matter in which occur ***bubbles***.

I have not been able to ascertain the presence of any tegument to the ovule, at any period throughout; it has appeared to me to be a homogeneous cellular body, for sometime it is a mere protuberance from the placenta: its point of attachment then becomes narrowed, and the upper face flattened; this flattening is the commencement of the groove. The groove exists at a comparatively early period; its fundus has the same structure apparently as the rest of the surface of the ovulum.

Still the edge of the ovulum looks too cellular, and not sufficiently lax for a nucleus, which appears in manifest modification of the usual form of foramen, and has no anology among really nucleary ovula, and the existence of the groove induces me to think that the usual appearances of ovule at particularly early periods of growth has escaped me, and that it consists of a tegument and nucleus intimately adherent; particularly as in *Congea*, in the later ovulum of which no difference of structure exists; I have seen indications of the annulus, the first step in the process of the formation of the tegument

[At this period of development the stigma is very large in comparison with pistillum which is obscure; the channel is even now closed up, it is a grumous cellular mass, pentangu-

lar, rounded or more convex on the under than the upper surface; above are the traces of a cup opening below a closed cavity, the articulation is just developing, and opens on pressure; sepals with veining ramifications above the base. Petals, etc. cellular, unequally emarginate. Subulate bodies exist.]*

In *Sarcostemma viminale*, the angles of the anthers on diverging towards the filaments leave a rounded space, which is shining and secreting.

Oil makes the pollinia very transparent, the terminal crest appears cellular, and is white with a yellow margin; the base of the pollinia may likewise have been seen covered with a white hyaline membrane, but its inflections inwards are not to be traced: this white basilar margin is continuous. The body is yellowish, and has a cellular appearance.

I believe the masses to be really cellular, the inflections white, each cell containing an intine.

In *Poinciana*, the pistillum in its young state is evidently a convolute leaf.

The mature stigma is a sub-oblique compressed channel, terminating in a stigmatic canal, and fringed with small papillæ.

The number of ovarial vessels is 3, all continued into the style, which is blood-red; stigma very inconspicuous.

The changes that take place by which the simple fleshy cellular homogenous body of Calotropis becomes a bilocular stamen, in some respects of remarkable complexity, may be thus enumerated:

This first change is the emargination of the apex, the second the tracing out, chiefly by a yellowish fuscous tint of the two cells; these are at this stage continuous with the general cellular substance of the anther. The next consists in the separation of the substance so marked out from the part of the anther surrounding; and at the same time that the cell is formed, which perhaps takes place at its apex first, the central part of the mass presents extremely mucilaginous

* Within brackets the MS. is partly written in pencil.

* *

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grumous contents, escaping easily on pressure. A short time afterwards and the cavity of the cell is distinct, and is filled by a grumous opaque elastic semi-adhering mass, consisting of some large, and an immense quantity of small granules or molecules. The walls of the cell after this undergo little change, the mass passes from a fuscous mucilaginous granular mass, into a similar mass contained in a positive and entire membranous sac; I believe this sac may be formed from the circumference of the grumous mass, its not presenting cellular processes between the massules is very curious?

The next stage presents an aggregation of the granules of both sorts, all of which are lightly and almost invisibly held together; the sac of the membrane becomes more dense and evident, and the massules of granules shew a decided tendency to become contained in a cell—the pollen grain.

The pollen mass has now arrived at the form it is destined to have, the subsequent changes only affect the yellow colouring of the membrane, and the greater distinctness and crowding of the pollen grain cells.

Such I believe to be the original formation of the anther; I am tolerably certain, the formation of the cell may take place alone by what I have called the dissolution into grumous mucilage of its interior, independent of any separation of that which previously formed the continuity of the tissue from the body of the anther.

As I have explained it, it agrees well enough with other formations, which I believe consist first of a separation of a mass from the body of the anthers, in which mass the pollen grains are developed. Beyond this it has little similarity or affinity with the usual plan.

The only explanation to be given I conceive is the one I formerly offered, and is this, that instead of the parent cells being many and only developing 3 or 4 grains, there is only one, developing an indefinite number. Passages (?) to this exist perhaps in certain Mimosæ, etc. The only anomaly in this is, that the parent cell does not disappear: of this I believe instances are known, as well as of their being alone in lines. It is difficult to reconcile this structure with

other plants of the same natural family. In Sarcostemma I should say the mass is itself cellular, the grains being lodged in distinct cells. This appears to be the case from the structure of the margin and crest, which last is obviously cellular: it is curious that though the crest is white, its dehiscing thickened margin is yellow.

On the structure of the margin, I am disposed to place considerable confidence: in all bodies consisting of cells, enclosed in a membranous sac the edges may always be seen very distinctly; on pressure no inflection is to be seen.

But when a body is cellularly subdivided, and cells containing others, no margin will be found, or if it should from any great thickness of the cells be discernible, it will not be a straight margin, but will follow the undulation of the marginal cells, and inflections will be found. The cellular structure has besides been shewn to exist in Asclepias by Mr. Bauer, and it is also in accordance with the observations of Mr. Brown.

From part of those observations it would seem as if in some, (*Asclep. purpurea*) the mass was nothing but one of perfect pollen grains, so even the inner series is separable, and each grain has an outer tegument.

The point in which Calotropis differs from the received mode of formation of pollen, is the simple membranous sac of the mass; the late appearance of the parent cells; the absence of any thing like ternary or quaternary division. The nuclei forming the grains themselves—It certainly consists of a sac containing a quantity of simple cells, having large and small granules within. The membrane, composing the sac, is not itself cellular.

The gland is at this time fully developed; its crura however have not reached the pollen sacs, it is naked at both ends; ovula, etc. remain.

The stigmatic tissue may be traced down to the articulation, or to the spot where the style begins to pass outwards; towards this it becomes more and more indistinct, and less recognisable from the proper tissue of the style. The disc has a cellular whitish appearance, quite different from the angles and interangles. The ovula have a very short stalk:

they appear at first simple, but slight pressure shews that the upper edge is deeply grooved. There is no distinction of teguments.

Obs. [(Pl. 23. —D.) Alabastrum 2½ lines, very globose, sepals erect just equal to the corolla. Processes with the recurved appendage for base, otherwise not much change except in size.

Obs. Sac now separates easily, it is undoubtedly a firm and thick membrane, the edge is continuous, and the last part filled up is the inner edge in the neck. Except this part it looks like a flattened mass of crowded, large, and very minute granules, presenting traces of cellularity.]*

[In the earliest aggregation of the grumous contents, I have seen some appearances of its taking place in the upper or narrower part of the sac at least, in transverse oblique lines.

The membrane is easily separable from the mass, which presents a somewhat cellular appearance, from the interstices between the future pollen grains being transparent. The cell of the grains is scarcely tangible although it is traced out, and the whole mass is held together in a curious inappreciable way; slight pressure is sufficient to cause the separation of the more distinct, but even in these the outline of the cell is more appreciable from the grumous and molecular matter, than from any distinct membrane. The original continuity of the future cell of the anther, is marked out by a grumous fuscous line.]†

Obs. (Pl. 24—E.) The walls of the sac have now the same grumous secreting appearances as they preserve subsequently.

The contents consist of a cohering elastic grumous mass, the circumference of which has most cohesion.

I see nothing distinct like traces of membrane.

The grumous mass makes its escape at this period very readily.

The glands at this time are two linear bodies, fuscous, inner ⅔ darker, adhering firmly to either side of furrow.

Head of the stigma quite solid.

* The MS. here is faintly written in pencil.

† Written in pencil.

The angles of stigma are not furrowed, although there is a leading thereto; the stigmatic tissue is well developed, but the linear arrangement of the cells is scarcely discernible, with a $\frac{1}{20}$ m.

(Pl. A.)—No 7. The cells have their future figure, and the margins are commencing to be distinct towards the apex. Contents, a grumous, highly minute granular mass.

Placentæ have assumed their form: more incurved than margins; cells indistinct, mucilagino-grumous tissue.

(Pl. 20 A.) Fig.—Series.—At this period the cavity of the cell is only traced out by yellow colour; if examined attentively it will be found to have the sides of the yellow part passing into one and the same with the body of the anther: it is also nearly solid; *the centre* contains a small quantity of grumous granular matter. See (Pl. 24.—E.)

Still earlier there is no yellow colour, the margins of the mass to be separated have chiefly towards the future apex become irregular, and distant from the mass. Pressure shews elsewhere that it is continuous with the body of the anther; the centre contains a small grumous mass.

So two changes go on: one, separation of the mass; the other, its dissolution into granular matter.

The mature gland is dark-brown; angular convex in front with a deep furrow.

Convex behind, no furrow, and rather more rough.

The crura are of the same colour, but less deep; the wing yellowish, passes down to the knee of the crus; the cellular membrane at the lower angle uncoloured.

The stages or changes as follows:

Separation of grume.

Appearance of sac.

Aggregations of grume.

Appearance of cells in intines.

Development of amylaceous granules.

From the action of iodine being confined to the contents of the grain itself, it appears as though the granular matter of the *nucelles* was exhausted during the formation of the outer coat. This agrees with direct observation, the young

grain from being granular becomes quite transparent before the production of the amylaceous granules.

Is there any relation between the structure of the leaves and of the anthers of unilocular anthered plants?

Obs. (Pl. 23.—D.) 1. [The glands are evidently secretions from the furrows, towards the angles of which they first appear, hence the want of a groove, the lateral lines marking out the future fissures now exist; it is along the margin that the crura are developed.

No division of the placenta now.

Contents of cell quite grumous, no subdivision.

Membrane just traceable.

But since it is evident that the mass is capable of developing cells, it is more consonant with probability to suppose that the membranous sac is developed from it also.

It is singular that when the ovule was flat, it had on one side two venules, while the other with incurved margins had only one central vein.]*

Obs. Sac easily separable, filled with grumous matter, scarcely any traces of cells in its external aspect. Yet it consists as in the perfect state of a sac containing simple cells with a granular nucleus. (Pl. 23.—D.) 5. [Appearance of cells, in the sac but only partial, when glands unite no crura, the grumous mass may be said to be just separating into massules.]*

Calotropis Procera.—Pl. xx. (A.)

1. Very early bud, calyx only developed; its centre is occupied by a mucilagino-cellular protuberating disc.
2. More advanced, traces of 5 lobes (petals) in the disc.
3. Considerably advanced, 1. 2. of pl. B. to intervene.
   Calyx laid open, corolla of 5 scales much like the anther at a more advanced period or of the next stage rather.

* Written in pencil.

3a. Corolla laid open, *3b* one of its petals, *3c* young stamen now a thick cellular grumous body, *3d* pistillum like the rim of a cup, slight tendency to lobes.

4. Pistillum more developed, now consists of two concave truncate scales with thick edges.

5. Corolla more advanced, *5a* same laid open, *5b* inner view of one of its anthers, *5c* pistillum, *5d* one of the ovaria.

6. Long section of genitalia of a bud, a little more advanced.

6a. Stamen of ditto, cells now sketched out.

7. More advanced bud, calyx spread out.

7a. Corolla spread open.

7b. Stamen, *7c* $\frac{1}{20}$ M. portion of contents of the cell quite amorphous.

7d. Petal and base of part of the corolla.

7e. Pistillum and one stamen.

7f. Lateral view of stigma of the same.

7g. Vertical view of the upper face.

7h. Under ditto ditto.

April 9th, 1841.

Calotropis Procera,—*(Continued.)* Pl. xxi. (B.)

1. Very young flower bud, calyx and bractea seen.
2. Same spread open, at this time the corolla is of 5 glandular or fleshy lobes: the stamina a solid mass with the marks of the future divisions, the pistillum a depression in the centre. Corolla nearly equal in length to calyx, which is just opening.
3. Vertical view of the corolla.
4. Corona, etc. inverted base of corolla remains.
5. Same, viewed opposite a stamen.
6. Inner view of anther.
7. Portion of contents of the membranous sac, which is represented in 8.
9. Pistillum. *9a* gland.

10. Ovaria, one open longitudinal section.
11. Placenta, on its inner face quite covered with ovules in single rows.
11*a*. Ovulum $\frac{1}{20}$.
12. Under view of the head of the pistillum.
13. Long section of corona and pistillum: intended to shew that there is a stigmatic surface which passes out at all places where the articulation occurs, and is spread over the whole face of the stigma; except the upper discoid portion: it belongs to a rather later period.

April 10*th*, 1841.

CALOTROPIS PROCERA,—(*Continued.*) Pl. XXII. (C.)

1. Corona staminea, opposite a stamen.
2. Ditto ditto, alternate with one.
3. Anther, internal face.
4. Elastic grumous mass contained in cell.
5. Portion of this $\frac{1}{20}$.
6. Pistillum.
7. One of the angles with the glands which are not united, and cohere strongly with the secreting furrows.
8. Long section of ovary.
9. Placenta, which is quite simple.
10. These belong to Pl. 21 B. No. 3.
 Double transverse section of part of stigma, the stigmatic tissue is seen occupying its circumference.
11. Same $\frac{1}{10}$, true stigmatic tissue.
12. These belong to Pl. 20 A. No. 7.
 Long double section of lower base of corolla and calyx.
13. Transverse double section of stigma $\frac{1}{10}$, linear cells visible under $\frac{1}{20}$.
14. Long double section of the part of anther through the cell, although there is no demarcation absolute, yet the parietes of the cell are yellowish and more

dense than the rest; the cell contains at this time a grumous AMORPHOUS *mass.*

CALOTROPIS PROCERA,—(*Continued.*) Pl. XXIII. (D.)

1. Corona staminea of bud $2\frac{1}{2}$ lines long.
2. Long section, base of corolla and calyx remaining, shews where the stigmatic tissue ceases.
3. Anther. 4. Transverse section of ditto, cells still present traces of irregular secreting walls.
5. Pollen mass. 6. Portion of the same: shewing its distinct membrane and simple pollen grains.
7. Transverse of ovarium. 7*a.* A gland of pistillum.
8. Double $\frac{1}{10}$. 9. Same under pressure $\frac{1}{20}$, groove distinctly seen.
11. Transverse section of the ovary of Pl. B. Nos. 6, 7.
12. Anther cell, the membrane perhaps attached by its broad end, edges of cell irregular and secreting looking.
13. Portion of contents.
14. Two grains. Shews that the cell is scarcely distinguishable.

April 11*th*, 1841.

CALOTROPIS PROCERA,—(*Continued.*) PLATE XXIV. (E.)

1. Cell of the anther and adjoining tissues, the fuscous line between these and the contents is the cavity of the cell.
2. Portion of the mass $\frac{1}{20}$. 3. Ditto to this, part of the wall of the cell seems to adhere.
4. Stigmatic apparatus of an angle.
5. Cell of anther and adjoining tissue—younger state.
6. Contents, portion of $\frac{1}{20}$.
7. Stigmatic tissue, transverse section of part of stigma.
8. Portion of the same including an angle, without a furrow now; $\frac{1}{20}$.
9. Transverse section of ovary.

* *

10. Placenta of one, $\frac{1}{20}$—and incurved part of leaf which is the opaquer part.
11. Stamen of the same.
12. Portion of stamen, earlier period ; in this the centre of the space marked out for a cell, is occupied by mucilaginous tissue. *12a* $\frac{1}{20}$, a little more advanced than 13.
13. About same period. Still earlier, doubtful appearance of single cells at apices of the part to be the cells ; in this also there were partial appearances of separation of the interior of the cell without any change in the interior tissue of the mass.
14. (Belongs to Pl. A. fig. 7.) Very young, no separation of any part, future cell marked out by the yellowish colour.

CALOTROPIS PROCERA,—*(Continued.)* PLATE XXV. (F.)

1. Corona staminea, corolla 3 lines long, nearly globose, twice as long as calyx.
2. Anther of the same, seen internally with an angle of the stigma and its gland, the neck of the mass is not yet protruded beyond the cell.
2a. Pollen mass of the same.
2b. Broad end of the same torn across $\frac{1}{20}$.
2c. Portion of contents of the same.
2d. Two of the pollen grains of the same.
3. Pistillum. *3a* Ovulum. *3b* Same, $\frac{1}{20}$ vertical section of upper face. *3c* Lateral section of ditto, $\frac{1}{20}$ shewing the groove.
5. Half of an anther more developed, just at the time the union of the glands and pollinia takes place, the neck of the mass is seen protruding beyond its cell.
5a. Inner face of gland at the same period, the crura are curled out at this time, they are very long and very elastic.
5b. Outer face of ditto, cellular appearance of the part between the end and the crura.

4 Half of an anther just before expansion of the flower, the union has taken place between the gland and pollen grains, and is very firm.

March 13*th*, 1841.

CALOTROPIS PROCERA,—(*Continued.*) PLATE XXVI. (G.)

1. Branch of inflorescence extremely early, in the axil of the lateral bractea is seen a mass, this is of a globose discoid form: quite entire and homogeneous, the central body presents traces of 5 *lobation*, and I imagine will be the calyx; in the centre is a slightly elevated disc undivided, the greater protuberance was a bractea, but what had it to do here?
2. The same seen on the opposite side.

3. *3a.* Lateral views of very young calyx and bractea.

3b. Same. 2 sepals removed, shews the great disc in the centre, from which hereafter the petals are to be formed.

4. Another calyx from same period, laid open, no depression in the disc.
5. Flower bud a good deal later, calyx spread out, petals even now united as seen in *5a*, the stamina are but slightly divided, and no trace of a pistillum is to be seen.
6. A little later, a depression seen in centre 5 angular depression, this with the elevation of the margin of the disc form the first steps in the evolution of the pistillum.
7. Mature gland cellularity analogous to that which occurs in the drying of spirituous solution of resins.
8. Stigma of Pl. A. 7—no furrows now exist. *8a* its transverse section shewing that the stigmatic tissue exists now.
9. Stigma, a little later, furrows just formed, gland commencing: decurrent lines from furrows now seen in the young gland, along these the crura will be developed.

*

9a. Under surface of ditto. *9b* oblique section of an angle and very young gland.

10. 11. 12. Evolution of the ovule.

Calotropis Procera,—*(Continued.)* Plate xxvii. (H.)

1. Corona staminea, expanded flower.
2. Inner view of anther.
3. Pollen mass.
4. Mode of union of neck of pollinia and crus of gland.
5. Portion of pollen mass, shewing that it is a membranous sac containing simple pollen grains.
6. Pollen grains.
7. Membrane of ditto *burst.*
8. Transverse section of stigma about its neck, and of the anthers.
9. Another section lower down the fissures now do not communicate with the stigmatic tissue.
10. Section transverse of styles just where they unite, each has its own canal; the central perforation shews the adhesion not to be complete.
11. One of the above almost entirely stigmatic, radiating from the canal.
12. Ditto of style where quite distinct, conducting canal with lax tissue.
13. Tissue of conducting canal.
14. Upper surface of stigma to shew the different appearance of the margins and disc itself.
15. Under ditto of stigma, shews that the stigmatic tissue is most developed on that part of the surface tending to the styles, and least opposite the faces of the anther.
16. Portion of stigma one of the angles, still stigmatic.
17. Ovulum.

April 19th, 1841.

Calotropis Procera,—*(Continued.)* Pl. xxviii. (I.)

1. Long double section of genitalia, during expansion.

2. Inner view of perfect anther, a pollen mass shewn in situ.
3. Transverse section of anther.
4. Ideal section of pollen mass.
5. Under view of gland.

STIGMA.

All corollas are originally or in their earliest periods of formation, polypetalous, and regular; and in all, the alternation of the parts is more or less distinct.

Therefore, a polypetalous irregular corolla represents long before it is matured, the mature state of a polypetalous regular corolla.

Consequently, a polypetalous regular corolla, in its developed state, is the most simple of all flowers.

A monopetalous regular corolla, in its earliest stage, is a polypetalous regular corolla.

A monopetalous irregular corolla passes through the phases of monopetalous and polypetalous regularity. It ought perhaps to present the following phases: Polypetalous regular, polypetalous irregular; monopetalous regular, monopetalous irregular.

It follows, that as irregularity is of later development, it is a more mature phase, that it is comparatively a sign of perfection.

Hence, irregular flowers are much more common in Dicotyledons than in Monocotyledons.

By irregularity I do not mean irregularity from abortion, but irregularity from an inequality, or increase of development: all appendages in some measure come under this head.

Signs of imperfection of Monocotyledons.——

In *Lindenbergia* the same phenomena occur. The axis of inflorescence will be found to present every gradation of structure, from the cellular grumous discoid termination of the axis itself, to the ringent personate perfect flowers.

*

The summit appears of an uniform cellular grumy character, even the last pair of bracts offer no exception; thence the next bracts will be found concave, provided with glandular hairs, those on the back being developed first: the axils of these shelter a convex grumous cellular body, presenting no traces of divisions.

In the next axils, the first indications of the sepals may be seen, the posticous one taking the lead in development, and so on.

The calyx arrives at some size and development before the corollula parts become united, and it preserves this ratio for a long time.

The corolla rapidly becomes monopetalous; the next change is irregularity, the lower ½ being much more developed, so that a lateral view presents an obliquity of the top of the corolla. The lower lip is outermost in these periods.

The anther before the union of the petals have a turgescent quadrilocular look. They are then nearly sessile, and broadly sub-reniform, but quite equal.

The lower end of the lobes now appear to take an increased growth, no change taking place in the original line of union with the connectivum, at the same time the filament begins to form. These two growths going on, the next stage presents the anther with separate loculi attached by their upper ends to the connectivum, and taking an unequal growth.

The pistil is the last part to appear; in its first state it looks as if the edges of the somewhat depressed central part of disc was fashioned up into a rim. I have never seen in it two distinct leaves, although the orifice presents traces of binary composition. The irregularity takes place very early, but the parts are so minute that I cannot say whether it occurs before or after the union of the petals.

At one time the corolla looks like a pentangular disc, with four elevations within four of the faces of the angles (the stamens); at this time there is no trace of pistil.

If the stigmata and production of the placentæ be marginal, the Lindleyan definitions of the style will require alteration.

But Lindley himself is not exactly consistent with regard

to his definition, since he quotes Schleidens, observing that a style is a portion of a leaf rolled up. Vide Int. p. 197.*

There can scarcely be much relation between the amount of convolution of the parts of the leaf forming the ovary, and that forming the style, since large stigmatic canals exist in plants, in which the septa are perfect; and consequently where no space exists between the margins of the leaves, (see Lind. p. 197,) the canal is made to depend upon the amount of convolution of the leaves themselves, not of their apiculi.

Probably in these cases the amount depends upon speciality of organisation.

Conclusions. Stigma is the external part of the conducting tissue.

In many cases it is obviously marginal, and its exterior portion a production from the placenta.

Its modifications are, with or without a superior sinus, with or without an anterior sinus, or with none.

The pistillum is a cuspidate leaf with its margins incurved. The ovarium is the lamina; the style the apiculus; the stigmatic surface the exterior part of the conducting tissue, or placenta.

The vessels of the lamina may pass into the style; very generally the midrib alone does so, and in all cases when only one vessel exists, it is the continuation of the midrib.

The pistillum may be evascular; in all these cases it is never foliaceous, perhaps the greater its vascularity the more developed is its green colour.

The lamina may be deficient of a midrib, having only marginal vessels; in such cases it occasionally subsequently derives a midrib from a recurrent vessel.

This suggests a question whether, (as no parallel case exists in leaves themselves, in which the midrib is invariably the first formed and principal vessel,) in such instances as Papaver, the midribs do not really bear the ovula. But Limnanthes is an undoubted case in point, and

* Third Ed. Lond. 1839.

as well as the venation of Compositæ is sufficient to show that this may occur, though in a way not very explainable.

The normal number of principal vessels of a simple pistillum is three—one midrib, two marginal; from which the ovula derive their vessels.

But this is often departed from, the pistillum may be evascular, and in many cases its venation corresponds to that of a palmate leaf. Vide Nasturtium, Cucurbitaceæ, etc. There is not necessarily any correspondence between the vessels of the ovary and those of the style, as might be expected in all cases as well as in Leguminosæ. There is a general correspondence between the number of midribs and fascicles of the style, although this is often obscured, as in Anagallis and Limnanthes, by the occasional prolongation upwards of a marginal or placental vessel.

It follows generally in compound pistils, that the composition of the pistillum is indicated by the number of vascular fasciculi of common united styles. Of this *Nolana* is a remarkable instance.

It is only theoretically that the apparent situation of the stigmata can be considered as affecting the situation of the placenta, for the cohesion between the stigmata of compound pistilla is frequently carried to such an extent as completely to obscure the original lines of separation.*

[I know of no instance in which the placental vessels arise from the midrib; they have an independent origin. Although in the generality of cases there is obviously a sinus in simple-pistil stigma, or a perforation with a confluency of all these sinuses, yet in many cases no trace of convolution is to be found in the stigma, which is the absolutely terminal point, arising both from the margins of the style and the conducting tissue.

There is nothing definite in the amount or limits of stigmatic surface; generally in cases of linear surfaces, it will be found spread over the inner face of the style in laminate stigmata, but remarkable exceptions occur in some Acanthaceæ.

* Here a blank occurs in the MS. and what follows between brackets is faintly written in pencil.

Practically, the stigma is the peculiar tissue which forms the external communication of the conducting tissue.

Theoretically, it is a production of the placenta along the margins of the carpellary leaf.

It was necessary to examine central placentation.]

If the stigma be the denuded apex of the midrib, its most simple form will be that of a punctum; from that point it may be assumed to be decurrent, thus including those stigmata which have an inferior or anterior sinus, but not those with a superior sinus; for, however liable organs of the same nature are to coalesce, I do not know any instance in which an organ becomes divided along its mesial line.

This theory is also objectionable as deriving the origin of the softest vegetable tissue, from the hardest portion of a leaf.

The true apex of the midrib is, I think, pointed out by the end of the vascular bundle.

Or, if cases exist in which the stigmatic surfaces occupy both faces of the style below the end of the vessels, it is necessary to allow that they may occupy the back as well as the front of the style. Examine gramineous stigmata and Compositæ.

The stigmata of *Nymphæa* are spathulate, furrowed in the centre, and spread over rays of a similar form, but prolonged beyond in some other species into a long incurved process. The centre of the whole is rather depressed, occupied by a conical fleshy cellular mass of small size.

Each of these corresponds to a cell of the ovaria, so that this is composed of many carpellary leaves, though conduplicated; the sides of each being ovuliferous, the channel of communication is the furrow.

The septa are evidently double; each side is lined by placental tissue, which is even thickened towards the axis, where however it has no ovula; these placentæ unite the carpella at the summit, and produce a structure like that of Hydnora, except that in Hydnora the carpels look convoluted. Even the ovula are inclined to encroach upon the dorsum, but they never rise from the centre.

The septa are reticulately venose, and are *distinct above*.

The stigmatic surfaces do not, as would be expected, always have a numeric relation with the carpellary leaves. Of this the only instance, I yet know of, occurs throughout Asclepiadeæ.

Were it possible to assume a quinary type of formation of the pistillum, the explanation would be easy, and the stigmatic lines would be double the number of carpellary leaves.

But this assumption is not warrantable; the number of carpella is obviously 2, whether the mature, or the very young pistillum be submitted to examination. The articulation takes place at a very early period. The relation which the glands bear to the carpellary leaves is curious: one leaf has one corresponding to its dorsal suture, two others to its margins; while in the other the 2 glands are half way between the margins and dorsal suture.

Of this curious structure I am unable to give any satisfactory explanation; the whole thing seems to me to turn on the close approximate adhesion of the antheræ to the faces of the stigmata.

Asclepiadeæ present most curious anomalies: the stigma is not perforated, so to say, by a stigmatic canal; although the opening corresponding to that canal is very manifest in an early period; the stigma is a solid cellular mass; hence the application of the pollen grains does not take place at the usual points, but along that which gives the readiest access to the canal. What is not a little singular too is the separation of the styles, and the concretion of the stigmata.

A thin transverse section of the disc of the stigmata certainly shews, that the whole outer face is lined by a grumous secreting stigmatic surface, which perhaps *explains why the glands are binary*, though it makes the anomaly otherwise greater; for it is unusual, if it ever occurs, to find the stigmatic surface occupying the dorsum of the carpellary leaf.

This secreting tissue is obviously continuous with the lining or contents of the canal of the style, into which it passes at the articulation.

A more beautiful provision could scarcely occur; for we not only have the stigmatic tissue occupying a most novel situation in consequence of the consolidation of the stigmata, but we have it endowed with peculiar powers of secretion to alleviate the difficulties occurring in the way of impregnation.*

* * * * * * * * * *

This explanation of Papaver, only assumes the intimate union of the stigmatic lines with each other. See Pl. 29. Fig. 1.†

The explanation by opposition assumes an axillary situation of placentæ very unusual if ever it occurs, and also a simple style having two lateral, and no central vessels, of which I had an instance.

Argemone mexicana.—In this the stigmata would be described as 4.5 reniformia, margine supero inter se confluentia. These reniform lobes are opposite the placentæ. The ovarial vessels are the marginal vessels (no dorsal vessels occur even in fruit) of the leaf, but the marginal ones send off numerous reticulating branches; on reaching the style, each passes up, separately from the marginal veins of its neighbouring carpella, and ramifies in the style.

The placentæ occupy the sinuses of the angles; the most convex parts of the ovaria are the dorsal of the leaves, and these correspond with the highest part of the stigma, as they should.

The stigmatic surface is evidently traceable to the placentæ.

Explanation as in Papaver; the reniform lobes are compound.

Pl. 29.—Fig. II. *a*, *b b*, *c*, *d*.‡ Papaver Argemone.

* A blank occurs here in the MS. intended, as would appear from what follows, to be filled up by observations on the genus Papaver.

† *a*, disk with stigmata; *b b*, sections of the capsule; *c*, substigmata distinctly traceable to the upper part of the Placenta by fleshy tints; *d*, style; *e*, midrib; *f*, stigma; *g*, venules of a carpel leaf.

‡ Parts corresponding to the same references in *Papaver*, Fig. 1.

Brassicaceous Cruciferæ.—Of the structure of this group the following explanations may be given.

1. It may be bicarpellary, the placenta being produced from the midrib of the carpellary leaves.

This will not explain the difference in structure between that which is supposed to be the midrib and the lamina; it will not explain the obvious cessation of the lamina along this line, nor the intimate union of the margins of the lamina—a union which has altogether the appearance presented by the dorsal line of most carpellary leaves.

It is, besides, contrary to all analogy, although perhaps not an improbable structure. Vide, excellent observations of Lindley on this point.

2. It may be bicarpellary, the placentæ corresponding to the margin of the leaves.

This however will not explain the separation between the placenta and the margins, as in the former instance; neither will it explain the manifest convexity of the style in a line from the placentæ, its depressed surface along that line where it should be most convex; nor the fact that the highest part of the style terminates this line. Besides, the venation is against this view.

3. It may be quadricarpellary, 2 of the carpella being reduced to mere laminæ without ovuliferous margins, and the others reduced to a midrib, and narrow ovuligerous margins, produced upwards into 2 perfect connate styles, and linear confluent stigmata.

This will explain every point of structure, and does not assume any thing outrageous.

It is borne out by the appearance of the exceedingly young pistillum, in which 4 involutions are manifest. It explains the separation in structure between the laminæ, and along the placentigerous lines, although the appearance of these with regard to a midrib is less satisfactory than could be wished.

It explains the rim visible at the upper end of the lamina between the placentigerous margins, which rim I conceive to represent the stigmata of the laminar carpellary leaves,

since they bear an obvious resemblance to the upper edge of the convolutions seen in an early stage.

If this hypothesis be found to be true, it bears strongly on Orchideæ, since it shews that carpellary laminæ may exist without any obvious style; hence the 3 ribs may be really abortive carpella.

This is a question of great importance.

If it be remembered, that the apex of the leaf is the part first formed, it appears impossible but that there must be some traces appreciable of the original number of carpellary leaves formed. Consequently, Orchideæ must have 3 stigmata at least.

In Edgeworthia buxifolia three actually exist, yet all are united by lines of stigmatic tissue; hence the usual stigma of Orchideæ may consist of three confluent ones.

In Erythræa nothing can be more satisfactory than the manner in which the margins are involute, or the evident origin of the ovula from their involute margins.

Between the edges of the leaves, and the first part of the involuted lamina, cellular tissue is interposed; but it has nothing whatever to do with the ovula. Nothing can be more distinct than the fact, that the pistillum in this consists of two concave or sub-involute leaves with thickened margins.

The pistillum is of latish formation, appearing after the anthers, or even perhaps the petals.

Pl. 29.—Fig. 3. *a*, very early, like a bilabiate capsule; *b*, opaque from air; *c*, placenta—*e*, continuation of placentæ with stigmata.

Why is it, that the whole inflected part of this leaf, does not bear ovula?

In Euphorbia the three styles are bipartite, each has one vessel which branches at the fork; there is a decided obliquity in the stigmata, and a connivance towards each other, which shews that they are not really independent organs. No furrow exists along the centre.

Pl. 30.—Fig. 5. *a*, *c*;—*b*, stigmatic surface.

The existence of the groove along the centre of very many linear stigmata, and its absence along the lobes into

which a simple style is occasionally divided, may be cited as proofs of its being a double organ; and the sulcus, I am inclined to adduce as an argument against the probability of the midrib of a carpellary leaf bearing ovula.

Few things can be more striking than the extreme similarity of all the parts of the flower at such periods.

The highly foliaceous calyx, the intensely coloured corolla, the complex stamina, are at such periods distinguishable only by situation; these last perhaps also by their internal convexities.

Out of such simple cellular bodies does nature organise a highly foliaceous calyx, an intensely coloured corolla, a complex stamen.

In the course of my enquiries I have submitted many pistilla to examination at very early periods. I have found that they consist at their first stage of a fleshy scaly body, convex on its inner surface. They may be often compared to a cup with an undulated margin, rather connivent or compressed. Each undulation marks the upper free edge of the carpellary leaf, and its highest point is the apex of the style.

The situation of the stigmata in some plants, such as Papaveraceæ, has appeared to many Botanists so anomalous as to authorise an assumption of the origin of the ovula from the midrib, although it would, to my thinking, be more naturally explicable by assuming an adhesion between the stigmata, somewhat analogous to that which causes the loculicidal dehiscence of fruits.

In stigma terminating as in the case of Papaveraceæ, just adverted to, the lines of union of the carpellary leaves may be two, either in the axis of the sinuses as in *a*. Pl. 29. Fig. 4, or in the axes of the teeth as in *b*. in which case the apex of the style will not be the highest point of the carpellary leaf, which it generally, if not universally, is. In neither, is there any difference in the amount of cohesion of the stigmata. The placentæ of Papaveraceæ, will be found as in *a*, in other words, a line dropped from the summit of each component part will fall into the space between the parietal placentæ.

The only anomaly, if it can be called one, is the intimate union of the stigmata with each other.

To explain *b.* if such an instance did exist, we should have only to assume that the axis of the carpellary leaf is not always the longest line.

It will be seen that I have adduced the venation of the style of Orobanche in favour of my argument, that that natural family only presents an apparent anomaly, and it appears to me to bear so strongly on this point, that it should always be taken into consideration in discussions on the nature of a given pistillum.

Very often the style has but one vein, which is a continuation of the axillary or dorsal vein, commonly called midrib; generally perhaps two marginal ones are superadded to the lamina, which only in some cases are prolonged up the style.

Even in those instances in which a simple style has several vessels, the central vein will be generally recognisable by its size.

It is in compound pistilla that the value of the venation as an evidence will be found to be greatest. For, although the number of the veins may, by the prolongation of one or more of the marginal vessels, exceed the number of carpellary leaves, it is in no case that I am aware of, ever less—a fact which, with reference to that very anomalous genus Punica, I take to be of considerable importance.

Most of the modifications of venation found in leaves may be found in the carpellary leaves, if examined at sufficiently late periods.

Nor are instances wanting of that peculiar venation of the corolla, characteristic of Compositæ, which we briefly and emphatically call Brunonian. In this case the style may obviously have 2 or 3 vessels: if 3, the central one will be found to be recurrent; at least so I have found it in Papaver.

Some idea may be obtained of the extent of the style by the vessels, which I do not find to be continued into the stigmatic tissue. Vide, Gramineæ on this head.

[From the stigma being nothing but the external communications of placental surface, arises in a great measure

the irregularity of its form; this is quite independent in some cases of the style itself, as in Acalypha, where the style is confined to the back, is green and undivided, while the stigmatic tissue is prolonged into sepal-like segments.

Pl. 40. Fig. 3.—*b*. style which is of green colour, *a*, *a*, *a*, stigmatic surface formed into segmenta, *c*, *c*, *c*, *c*, generally 3-4—2 in front.]

In Trichodesma, the stigma is papillose, arising both from the margin of the united styles, as well as from a very distinct cord of dense fibrous tissue, which occupies the whole of the canal; and which on reaching the base of the style, spreads out a lax lining of the branching cyclotic tissue, which establishes a direct communication with the placenta of each ovulum. The transition from the elongated dense cells of the conducting tissue, to the short, lax, oblong papillæ of the stigma itself, is very abrupt.

The style has two vessels, as usual. The raphe is next the axis; the part of the ovarium corresponding to the cells, is of different texture from the rest; the cells look as if imbedded in torine tissue, but this is as continuous with the style as the other; and besides, the young ovary is uniform, and the situation of the vessel between the cells shews that the torine tissue is ovarial.

Therefore " there is occasionally a difference in tissue between the part of the lamina of a carpellary leaf, as in Trichodesma, in which the tissue of the cell is very different from that of the rest, to which the induration that subsequently takes place, is confined.

In Echinops the stigmatic surfaces are as in Aplotaxis. There is this difference, however, between the dorsal of the separated part of the style, that the hairy portion is confined in Echinops to the upper half, originating as in Aplotaxis from a sort of annulus of larger and denser hairs.

In this plant also, although there is as usual only 2 vascular bundles towards the base of the style, yet from the subdivision of these above the stigmatic part of the styles may have as many as 3 branches. This is the only instance of the

kind I know of in Compositæ, or in any plant with a nonfoliaceous carpel.

The stigmatic surface occupies the whole of the innerface of the style, this is in the first place flat: but as it approaches the canal, it becomes concave.

The styles are throughout the divided part, very closely approximated: the stigmatic surface as an opaque object, appears as a whitish streak, occupying the line of approximation.

Very generally, there is a marked difference between the dorsum of the style, and the stigmatic portion of its inner face. This difference may be rendered obscure by a variety of causes, but by none more than a hispidity of the dorsum itself, a structure not uncommon in Compositæ.

When the pistillum is composed of 2 carpels, almost entirely closed, as in Lithospermum, the only constant effect of syncarpism, so far as regards the styles and stigmata, consists in the presence of one stigmatic canal.

In the upper part of a divided style, there may be several, but throughout the undivided part there appears to be constantly only one.

Somewhat analogous instances in which there is a lamina, a midrib, and then a convolution of this, occurs in Nepenthes.

The stigma of a simple carpellum presents very generally an obliquity, with reference to the style. The only instances I know of, in which this does not appear to exist, is in Umbelliferæ and Lithospermum, in which the mature style appears really terminal, an appearance which might arise from an infundifuliform-apexed style, and a marginal stigma in an intimate state of cohesion.

The apex of the pistillum, i. e. the apex of a carpillary leaf, is the part first formed. In no case is this more remarkable than in Asclepiadeæ, (Calotropis) in which at a very early period, the pistillum consists of 2 laterally inside concave bodies (slightly rolled leaves); these bodies are certainly the part that subsequently forms the stigma.

For this reason whenever an attempt at a compound pistillum is made, evidences of the apices of its component

parts must exist, unless it can be proved that similar parts once formed, may be absorbed.

The presence of the rudiment of a style, is in my opinion proof of there being an additional abortive carpellary leaf. The other perfect carpella may be vascular, the rudiment may not only be evascular, but that part of the ovarium below it, which should be its lamina may also be evascular, yet the proof would not be fatally shaken. I can easily conceive that processes may originate from an ovarium, but in these cases especial regard must be had to their situation, as for instance in Gramineæ, and if belonging to developed carpella, they will not be single, unless they grow from the dorsum.

Penetration before the ovulum is reached, must only take place in a stigma in which the component parts are in a state of complete adhesion, or in which, as in Anagallis, the canal is stopped up by stigmatic tissue.

This is seldom, if ever the case; in compound styles a central depression exists leading directly into the stigmatic canal, or this may have a distinct aperture; in simple styles the access to the canal of communication is generally very easy. In these cases what is the course of the *boyaux?* Do they pass over the stigmatic tissues into the canal, or through them? In such instances as Meyenia etc. penetration can hardly be allowed.

As a definition of value, in putting one on one's guard against laxity of description of stigmata, I may cite Lindley's. "Nothing is properly speaking stigma, except the secreting surface of the style." Although there is a want of precision in the term secreting, there is always a peculiar aspect of the stigmatic surface, by which it may be known from that of the style.

Somewhat of a similar kind of misplacement of the stigmatic tissue occurs in certain Meliaceæ, such as Dysoxylum

In Dysoxylum or Hartighsea, in which the styles are throughout united and expanded into disc at the summit, the centre of which is as usual depressed, the stigmatic surface is confined to the lower half of the margin of the disc.

In this case it is assumable that the pollen tubes pass in immediately, not first proceeding to the summit. In many cases the true passage of the stigmatic canal is only determinable by fecundation.

[The stigmatic tissue is decided; it surrounds the whole base of the stigma, being the base of the upper part of the fissures, it passes down converging into the stigmatic canal.

The style has a large canal, filled with stigmatic tissue, of lax, variously shaped cells, with lax greenish globules, the fibrous tissue of which has one dorsal vessel, around which are cells.

The difference in aspect between the disc of the stigma and the margin is obvious; the one is green and cellular, the other mucilaginous-looking: in consequence of the furrow in the stigma along the line of sinuses, a transverse section at particular portions will present bilobed angles.

Few cells, if superfices are once out of the embryonary sac,—tinged, grumous spot at apex of nucleus,—no sac,—no vessel.

Style where united is certainly papillose, the cells appearing to radiate from two purplish spots, between which is the softest tissue, i. e. the stigmatic canal, the whole style stigmatic, except the dorsum and tissue round the dorsum vessel.

A series of transverse sections shew, that these pink spots radiate as they pass up, until they become semi-circular lines.*]

In *Cordia*, Plate 30—Fig. 4, the ovarial vessels are two, the styles are apparently two, each bipartite; and each branch has a vessel, the bifurcation taking place a little below the division of the branches of the styles *a*, etc.

The stigmatic surfaces are limited to the inner faces of the divisions. The explanation is twofold, either there are two carpellary leaves, the styles being bilobed, or there are four, in which case the vessels of the ovary will be limited to two of the sinuses of adhesion.

There is an amount of laterality, which favours the former supposition, but then the vessels of the style should end at

* Faintly written in pencil.

the separation of the lobes, and the stigmatic surfaces would occupy the whole surface of the divisions.

But in an early stage the divisions of the ovary are of unequal extent, two deeper, evidently pointing out the limits of carpellary leaves, two styloid divisions.

The ovary itself is evidently bicarpellary.

In *Saponaria* of Hindostan, the stigmatic surface occupies a narrow line, extending the whole length of the style on the inner side: this line becomes wider and more developed towards the apex, the whole of which it also occupies. Pl. 30—Fig. 3, *e*.

The ovary *d*. Fig. 3, has four vascular fascicles, those corresponding to sinuses of carpellary leaves send slight ramifications from their apices to the dorsal vessels. The placental supplies are *peculiar*, as must be the case, in all free central placentæ.

Compositæ have essentially linear stigmata with a confluence of the superior sinus. Pl. 30—Fig. 3, *e*.

The termination of the vessel below the point where the stigmatic surface may begin to be *reflexed* (?) to the dorsum of the style, appears constant.

Ranunculus sceleratus, has a very indistinct stigma; the vessel is single, very clavate, the raphe (if there be one,) at any rate, the dorsum of the ovule, is next the placental suture. Pl. 33—Fig. 13.

In *Veronica Anagallis*, the adhesion between the stigmatic faces takes place very early; or rather, even at a very very early period, there are but obscure traces of the composition of the pistillum.

The anthers are of large size before the corolla has scarcely made its appearance.

The adhesion between the styles is perfect, but the vessels are *two*, these are the dorsal ones, a small marginal one also occurs.

The pistillum at a very early period, is a fleshy body, depressed at its apex into a concavity, at a still earlier period there are two depressions. Pl. 29—Fig. 6.

In *Melilotus albus*, the ovarial vessels are 3; 2 incomplete,

marginal, not produced beyond lamina, one dorsal, terminating just below the oblique stigmatic surface.

It is curious that the most convex oblique edge of the ovary is occupied by the placenta, which is certainly not usually the case, and the highest point of the style is also opposite the ventral suture, whereas generally it is opposite the dorsal. Pl. 29—Fig. 5. *a*, Branches not ovuligerous.

In *Celsia coromandeliana*, the lamina of the leaf is very vascular, anastomosi retiformis. Two stylar vessels as usual clavate, terminating higher up than usual.

Polygonum aviculare, (Trigynia,) presents three very faint ovarial, and styloid vessels.

Clerodendrum. The style is 2-lobed, stigmata lanceolate marginate on the lower half of the style's lobe; above confluent, occupying the whole inner face of the lobe, all stigmatic; vessels of the style 2, terminal linear, and within the *end of the style* itself, lamina of ovarium vascular anastomosis, style 2 vessels. Pl. 30—Fig. 5, *a*. etc.

In *Carissa Carandas*, the stigma is spread over the whole surface of the style below the apiculus, originally bilinear, marginate, incomplete above, this is traceable, but obscurely: vessels two, terminating just below the apiculus. Pl. 33.—Fig. 1. *b*, back view *a, a*, lateral ditto.

In *Agati:* the stigma is clavate and strictly terminal, although a slight obliquity may still be observed towards the ventral suture.

The style is very vascular, consisting of three stout bundles, the dorsal is a little longer than the ventral side; the stigmatic canal is large. Pl. 33—Fig. 16, *a*. lateral *b*, back view.

In *Capparis:* the stigmatic surfaces are united in a truncate mass, terminating the style, and perforated in the middle by the stigmatic canal. The carpellary leaves are very veiny, and anastomose; the principal axis terminating at the end of the lamina; earlier, there are as many lobes as there are carpellary divisions: 1 dorsal and 2 marginal, very anastomose.

Pierardia. Has very unequal stigmata, the posterior being as usual in the order, several times smaller; the

vascular fascicles end just where the stigmatic surfaces pass on to the dorsum of the style, or rather pass beyond the midrib in a confluent state; the style is at the base anteriorly very gibbous, and the space between the two lowermost carpella is considerable; the 2 uppermost being in apposition.

The venation of the divisions of the ovary is, one outer or dorsal vein, and about 2 others on either side, confluent with the dorsal one, which passes almost entirely round the division, but does *not as it ought to do* (?) run again into the fascicles supplying the style.

The gibbous base of the style of the anterior carpellum is worthy of remark, as proving that even filiform growths may have a tendency to division.

As it has thus an independent venation of its own, it may be assumed to represent a pinnate leaf, with a single pair of leaflets, and an exserted petiole.

This hypothesis however is merely arbitrary, merely referring to the resemblance in configuration between the two, equally assumable as a palmate leaf. Labiatæ prove clearly, that great inequality may exist between the stigmatic surfaces of the two carpella, without any corresponding inequality of function; but this is as it should be, for whatever inequality may exist between the stigmata is compensated by the equal, free communication all the carpella have with the stigmatic canal. Of this Viola is a marked instance, as well as Orchideæ.

In a Carduaceous genus, the stigmata might be described as linear subulate scabrous, commencing from a hispid ring at the bifurcation of the style. Pl. 30.—Fig. 3, *h*. 1, 1, stigmatic surface.

This would not be the true structure, the real stigmatic surface is linear sub-involute, occupying all the inner face of the styles, and produced beyond its apex into a mucro.

Both, form a channel leading directly into the stigmatic canal, having 2 vessels, terminating just below the scabrous end of dorsum.

In a Lactucaceous genus, formed on the same plan, the limits of the stigmatic surfaces are obscure by its being

scabrously papillose, a quality which it enjoys equally well with the dorsum of the style. The termination of the vessels is just within the apex.

The limits of the two surfaces are, however, distinct in opaque views, the papillæ of the stigma being marked out by a yellower line; they are likewise more thick set and smaller than those on the dorsum of the style.

In *Myriogyne*, a similar thing takes place; the stigmata are lanceolar, and the distinction between style and stigmata is very obscure, the papillæ of style are the largest: the vessels end as usual.

Mazus rugosus. The style is divided at the top into lamellæ, of which the lower is biggest; the whole inner faces and margin of these are very papillose; the vessel of each, ends rather below the middle. Papillæ become smaller and smaller toward mouth of stigmatic canal.

In Medicago minima, the lower margin of the dorsum of the ovarium is very gibbous. The ventral suture is nearly straight, the opposite in this respect of Melilotus. The stigma is obliquely capitate, the obliquity is opposite to the ventral suture. The venation is 1 dorsal, 2 marginal, all incomplete, and none produced any distance up the style. Pl. *33*—Fig. 7. *a*, dorsal vein, *b*, lower margin.

In Anagallis, the style is undivided, 5 vascular vessels with clavate subdistinct ends occur, and the stigma constitutes a papillose rim at the end of the canal; the ovarial vessels are 10, 5 dorsal, and 5 interstitial. The number of style vessels is obscured by the occasional passage of one of the interstitial vessels. The stamina are much earlier in development than the petals, and the stigma is mature in outline at a very early period. The anthers are bilocular, loculi bi-locellar. side by side, but rather obliquely. The stigmatic surface extends not only from the rim, but from the conducting tissue itself. Pl. *33*—Fig. 15. *a*, section of style, *b*,—$\frac{1}{20}$.

Eclipta, presents linear stigmata, occupying the whole inner face, and confluent beyond the apex of the *vessel.*

Ranunculus acris. Stigma oblique, papillose, disappearing gradually down the ventral suture.

Ovarial vessels 3, 1 dorsal, 2 marginal, subequal, clavated subconnivent at the points. Raphe next the ventral suture. Pl. 34—Fig. 1.

Lotoides (found near Anopshelun): presents an instance of a terminal stigma to a simple style, the style is very hairy, and below the stigma, which is laxly cellular, oblong; the hair surrounds it like a cup. Pl. 34.—Fig. 2. *a*, *b*. Primary ovarial vessels 3, 1 dorsal, 2 marginal, these last are continued a long way up the style; sides with anastomosing veins; principally, if not entirely, from the marginal veins. The ventral margin is most convex, ovules 2, from nearly the same point.

Potentilla, presents, the common sub-apetalous prostrate one. Ovarium *b*, *e*, very gibbous: the gibbosity occurs along the dorsum; style very laxly organised, not much more so than that of mosses: stigmatic canal very large, yellowish. No dorsal vein, two marginal ones, which do not enter the style. Pl. 34.—Fig. 3. *a*, *b*, *c*, *d*.

Lithospermum, presents no distinction of dorsal and ventral stigmata. Pl. 34.—Fig. 5. *c*, situation of nucleus; *d*, two stigmatic canals; *b*, outer view of stigma; *e*, inner view, and *a*, outer view of the young ditto.

Composita Echinopsidea, capitulis rubris. Styles united, except at the apex, covered with beautiful rosy papillæ, larger toward the base, vessels 2, terminating just within apex. Stigmata minutely and densely papillose covering the margin, and concavish inner face of the lobes of the style. Pl. 33—Fig. 6. *b*, lateral, and *c*, dorsal view. The papillæ of the style do not seem to excite the pollen tubes; see A, in contradistinction to B, in which boyaux are emitted. (Species from Futtyghur.)

Acanthacea, (Ruellioid. Also from Futtyghur.)

In this the lobes are very unequal; both are evidently lined by a marginal stigmatic surface produced beyond the apex, at least in the lower lip, and united on the middle line, along which they form a cellular crest. Pressure separates the two lower lips, the vessels are 2, both ceasing within the apex of either lobe, the ovarial vessels are about 5, but the central one alone is prolonged into the style. Pl. 33—Fig. 8,

Dotted line *c*, represents separation of style and stigmatic surfaces; continuation with stigmatic canal distinct.

In Aplotaxis, the stigmata cohere intimately; they do not appear ever to become separate, the line of sphacelation, consequent on fecundation, is confined to a line along the centre of the otherwise hispid style, a proof that the stigmata are confined to the inner surface and margins of the lobes of the style.

Labiata, (found near Futtyghur.) No sulcus occurs, but a linear lanceolate stigmatic surface, is produced into a point beyond the style and its vessel, and communicating inwardly with the stigmatic canal. Style anteriorly with a cellular ridge at the base, and a tendency to swelling all round; raphe external. Pl. 33.—Fig. 2, *a*, *b*.

In Daucus Carota? the styles are two, simple cellular, with a considerable conducting canal, which expands above into a capitate truly terminal stigma. Pl. 33—Fig. 9. *a*. *b*.

The gland is so intimately united with the style, or rather its structure passes so much into it, that taking this in connection with the variation of size in the glands of Callipeltis, I shall not be surprised if these, and some other epigynous glands prove to be dilatations of the style; early anatomy alone will put this beyond a doubt.

Nerium Oleander: quadruple corolla, each petal of each series having a corona, outermost petals smallest, innermost obviously modified stamina, the middle being prolonged into a hairy filiform process like that of the filament. The processes of the corona in the outermost series are developed from the sinuses of the petals, but in a less degree than from their faces.

Pistillum developed into stamina.—How are such instances to be explained? they shew the intimate relation between petals and stamina, the number of additional series ought to have some relation with the glands. Between the mature stigma and that of Asclepiadeæ, there is a considerable deal in common, and perhaps apocyneous stigmata may be considered as in some degree bearing on my explanation of an asclepiadeous one. In Nerium Oleander, although the

stigmatic surface in the mature flower occupies the whole division of the style, forming a disc from the centre of which the apex of the two united styles project, it is reducible to the most simple form by its study in its early stages. In these it will be found to have two linear faces beyond which the apex of the style projects. The two stigmatic surfaces are confluent below, even now. Pl. 33.—Fig. 10. *c, c, c,* stigma, viscid; *a, a,* lateral views of very young stigmata; *b,* back view. See also monstrosity *h,* one style chiefly developed into a hairy like filament still having two small linear surfaces; *d, d,* style; *e, e,* stigmatic; *f, f,* apex of perfect ditto.

In Gramineæ (Pl. 33.—Fig. 5.) it is the branches only of the style that are stigmatic; these are papillose, or rather toothed, while there is no tendency to this in the main trunk, except towards its apex. The pollen grains are excited by the branches alone, and the boyaux penetrate into them, and so pass into the canal of the main trunk. The canal and its branches are scarcely to be recognised but by the passage downwards of the boyaux, or rather by the grumous contents of these. Such appears to me the most probable explanation, although there is no demarcation of structure at any point, as there is between the structure of the style and conducting tissue in other less cellular styles. Early anatomy may throw some light upon this. Tincture of Iodine in this case only acted upon the contents of the grains, the tube remained uncoloured; the ovary from the immense number of molecules appeared a blackish blue. The remaining tissue was entirely changed to a fuscous brown, like the colour of the tincture.

Dalbergia Sissoo. Stigma terminal capitate, fungiform, alveolus in the centre; in the young stages the ovary has 3 vessels, 1 dorsal, produced up into the style nearly $\frac{2}{3}$; 2 marginals, ceasing at the base of the style. These last are formed last, by extending into the lamina at a time when the dorsal vein is perfect. Pl. 33.—Fig. 3. *a,* ovules on the wrong side; *b,* stigma. [Stipules scales of buds, no stipels.]

Pollenic action causes a marked sphacelation, stigmatic tissues loaded with grumous matter, almost throughout the

style; hence the canal must be large, the foramen looks upwards, and raphe is next the axis.

In Cyperaceæ, the styles are much more highly organised, each has a dorsal vessel, the stigmatic surface is confined to the inner surface, prolonged beyond the apex?

Alhagi maurorum, has a simple terminal stigma, the whole orifice of the canal being stigmatic, the outer parts of the margin with oblong papillæ, from the centre of which projects an oblong mass of stigmatic tissue. Pl. 33.—Fig. 4. Veins 3, one dorsal ceasing a little below the stigma, 2 marginal ceasing 2-3 up the style, or nearly all equal. Altogether analogous to the Lotoid structure.

In Bassia, the many styles are intimately united, the style has many vascular fascicles, arranged in a single series round the central tissue, which is not perforated. The stigma is terminal, punctiform, it is exserted, long, ante antheria or before the dehiscence of the anthers. The tube of the corolla will after the bursting of the anthers, be found loaded with pollen, which can only get chance access to the stigma. Hence perhaps the deflexion of the pedicels.

In the hairy ovary, calyx, consolidation of the corolla by intimate union with the filaments, and the exsertion of the style, it approaches Edgeworthia.

The decurrence of the filaments down the corolla tube, shews that this is corolla not torus? Stamina in about 3 series, Coroll. 2 series. 9. Inner rows of stamens irregular, the upper and outer rows are in the sinuses of the petals.

In Lindenbergia, the ovary has several fascicles, the dorsal only carried up, terminating clavate from below the stigma which is papillose, and obscurely bilobed.

Polygonum, has three terminal stigmata, and 3 vessels, 1 dorsal vessel to each carpel.

Croton like Trewia, has a bilobed style, with highly developed cellulo-papillose stigmatic surfaces.

In *Pardanthus Chinensis* the angles of the ovarium, or carpellary leaves, are opposite to the outer and larger divisions of the perianth: Pl. 34.—Fig. 6. *a*, æstivation, *b*, bract. Vascularity of the ovary 6, 3 dorsal, 3 placentary of the base

of the style each above bifurcate into 2 distinct clavate branches; hence the base of the style is always to be examined. The primary vessels of style are perhaps placental.

In *Zephyranthe candida* the usual monocotyledonous arrangement takes place, and the due alternation and opposition occur, the carpellary leaves alternating with the inner row of stamina, and being hence opposed to the outer sepals. Pl. 34.—Fig. 7.

In Zephyranthes rosea, any addition to the number of sepals and stamens is attended with a definite increase in the component parts of the ovarium; in an instance before me in which there are 4 petals or inner sepals, there are 7 stamens, and 4 divisions of the style. In another, in which there are 5 inner sepals, there are also 7 stamens and 4 lobes of the style, the 4th lobe being smaller, and separating from the common style a little lower down. In both the above there are 4 carpellary leaves, 3 opposite the 3 outermost sepals, the 4th smaller, opposite the outermost of the inner series. In Zephyranthes grandiflora, a still greater increase takes place, thus in a specimen before me, there are 8 divisions of the perianth, one of the outer ones decurrent on the ovary, and the apex of the scape, 4 outer, 4 inner, 7 stamens, one of the inner series of sepals being developed opposite the decurrent one, 5 stigmatic lobes, 5 carpellary leaves, 4 opposite the 4 outer sepals, the 5th opposite the outermost of the inner ditto. All this bears on Falconer's second Dendrobium, in which the carpellary leaves vary in number with the divisions of the perianth. It is obviously connected with the double opposition of the triandrous Iridaceæ.

In *Marica*, which represents in its family the sitalpatte of Marantaceæ Phrynium, the carpellary leaves are opposed to the outer sepals. Pl. 34.—Fig. 8. Reverse, the third angle being next the bract.

The stamens although their true relations are disguised by some adhesion, are obviously opposed to the outer sepals, from the central vascular fascicle of which their vessels are derived.

Curculigo Orchioides.—In this, although from the slight twisting of the tube some obscurity is caused, yet I believe the carpellary leaves are opposite the sepals, at any rate the angles of the stigmatic canal are, the partium situs and alternation is therefore as represented. Pl. 34.—Fig. 9, *a*, stigmatic canal. The venation of the stigma is Brunonian.

Curculigo Sumatrana, presents curious cells around the loculi of the ovarium. Pl. 34.—Fig. 10. *a*. bract.

Curcuma.—Such appears to me the situation of the parts, (Pl. 34.—Fig. 11.) although it is not easy strictly to determine the relations of the two glands. These are certainly placed against the outer sepal, so that it may be fairly assumed that they are opposite the lateral inner sepals. No obliteration takes place in Curcuma. The pollen has a simple outer coat, membrano-coriaceous, the inner is filled with starchy matter. The outer coat is demonstrable by *rolling* under a bit of glass, otherwise it is so like an inner coat that it is with difficulty recognisable.

Jussiæa.—The cells of ovary are equal and alternate with the sepals, hence the opposite petals, and inner row of stamina. Pl. 34.—Fig. 12, *a*. Style increasing at both ends, above dilated into an obscurely pentagonal rim, on this the stigmatic surface is developed in its rounded lobes, opposite the angles of the rim, and opposite the sepals! So that the lobes and the cells do not correspond in relation, hence the lobes are compound, the lines of adhesion between the different surfaces being quite obliterated. This is proved by observation at very early stages, in which the only evidences of pistilla are 5 lobes of centre opposite the smaller stamens; the petals at this period are very minute, and the smaller stamens are then certainly outside!! Pl. 34.—Fig. 12. *b*, *c*.

1. Sepals.
2. Petals.
3. Stam. largest.
4. Stam.
5. Carpella.

Cyathocline.—Styles quite united, not separable on pressure. Surface papillose, but not altering the pollen apparently,

vascular bundles large, two of them less papillose at apex. Receptacle of central flowers fleshy, rugose, concave, barren flowers arranged outside, under and all round it. Odor Labiatoid. The greater perfection of the central flowers in this case shews that the spike is compound ? Pl. 34.—Fig. 13. *a.* involucre.

In *Villarsia* grandiflora, the placental tissue may be seen converging towards the opening of the stigmatic canal in a marked manner. [No glands, is there any relation between the want of these and the abundant cellular hairs of corolla ?] The stigmata in this are as many as there are placentæ, they are folded outwards; all the inner surface is stigmatic, as well as the outer, except the central line, or midrib. The stigmatic canal is well developed, but little papillose tissue occurs. The lateral ovarial vessels run up into the base of the style irregularly, presenting above only one fascicle, as usual clavate: and a laminar stigmatic surface, dentate or lobate, folded together outwardly. *V. cristata,* presents a cordate stigmatic surface, with a tendency to recurve at the sides. Externally the surface is marginal, confluent at the apex, and internally covers the whole surface, the raphe is complete, but the crest is not formed till long after.

Pladera. Juice of ovary sub milky, stigmatic surface right and left, laminar, style vessels 2, very small. Corolla 4-partite, 2 smaller lobes oblique, united one-third up; contiguous halves folded back, forming a niche in which the anther is sheltered. Tendency to irregular flower, in one additional stamen, petaloid in one sinus.

Tacca pinnatifida. Perigonium herbaceum superum, ultra medium 6-partitum, laciniis lineari-oblongis, exterioribus majoribus. Stamina 6, sepalis opposita et adnata. Filamentis latis marginibus cohœrentibus, incrassatis, lividis; parte libera, deflexo-inflexa in cucullum album, antheras fere omnino obtegentem; apice 3-dentata, dente medio, e connectivo. Antheris bilocularibus, loculis linearibus, arcuatis (the arch pointing outwards, owing to deflexion) apicem cuculli fere attingentibus. Ovarium fere inferum, parte liberâ apice

lividâ, papillosâ, quasi marginatâ. Styli 3, in unum coaliti. Stigmata maxima obcordata, discreta; (taken together) aspectu fungoideo. Punctum impregnationis foveola transversa in vaginæ facie infera; basi partes dilatatæ. approximatæ. Under surface alone papillose, and that only about the opening. Placentæ 3, sepalis majoribus oppositæ (stigmatic canals at first distinct, below all confluent,) one vascular fascicle terminating clavate, opposite the fissure. Pl. 34.—Fig. 14.

This appears to me certainly allied to *Isthmia*, it approaches it in the deflexion of the stamina, by which introrse anthers become extrorse, in the thickened or raised margins of the filaments, the riband-shaped suture of dehiscence of anthers; bilobed stigmata independent of the primary points of agreement. The stigmatic canal is very remarkable, and certainly does not seem to favour impregnation. The great discoid upper surface acting as an umbrella. It is an exception to the general occurrence, the stigmatic surfaces almost invariably occupying the inner face of the prolongation of the carpellary leaf.* Pl. 34.—Fig. 15.

Pontederia vaginalis. The larger stamen is opposite to the lower, and the third sepal; there is a tendency to oblique *fecundity* in the stamina upwards. Pl. 34.—Fig. 16.

In *Iris* the alternation, so far as the stamina and stigmata are concerned, is really regular, although the stamina and stigmata would both appear to be opposite the petals It is curious that the angles of the free portion of the style, do not, as they generally do, represent the conduplication of the component parts; but on the contrary, represent their lines of union. Nothing can be plainer than the 3 conduplications with each margin projecting inwards, forming double lines above, passing off into the stigmata. The composition of the stigmata is further pointed out by the vascular bundles, which are two on either side of the cellular central line. Analogous to *Limnanthes.* What represents the outer series of stamens? Pl. 34.—Fig. 17. *a* line of union of

* For further illustration of this species, see Pl. 28.—Fig. 3, *b. c. d.* etc. [l. too early for the separation of the nucleus from the inner tegument, *e, e,* outer coat; *f. f.* second ditto; *g.* nucleary ditto; *h.* inner embryonary ditto doubtful; *i.* nucleary cavity.]

the stigmata, *b.* carpel leaf of style, *c.* line of union of ditto, presenting distinct fissures.

In *Gloriosa* the alternation is complete.

Sepals.
Petals.
Outer Stam.
Inner ditto.
Carpella.

Pitcairnia bromeliæfolia. Pl. 34.—Fig. 18, *a. a.* bract.

Crinum, Pl. 34.—Fig. 19. This is the same as *Polianthes;* the ovule or seminal cavities are opposite to the petals, but lines of communication or stigmatic surfaces are opposite the sepals, hence these analogically correspond to the cavities of the carpellary leaves, which are prolongations inwards and downwards of the furrows of the stigma, hence they are spaces pointing out the composition of the pistillum. They exist in *Funkia*, which is amarylled in appearance.

Calosanthes. Pl. 39.—Fig. 1.

[Stage 2. *a.* Stamen, *b.* plane of verticillus solid.
" 3. *a.* Carpel leaves, have no right and left disposition.
" 4. *b.* anterior, and *c.* posterior. *(a)* No disc.
" 5. *a.* Upper, *b.* disc.
" 6. Stamens still hypogynous. Stigma now evident, lamellæ anterior 0, posterior. ?]

It would perhaps seem to follow as a matter of course, that a corolla developing in protuberances from a solid plane must originally be composed of as many parts as there are protuberances. And as these points correspond to the future petals, it would hence follow that all corollas must at some period or other be polypetalous. And this I think I have observed to be the case, although the appearances are obscured by the likeness, when viewed externally, the internode has to the tube of a young corolla. A doubt has been also suggested to me by the earliest development of the ovarium which has first appeared to me not unfrequently in the shape of an entire annulus, its protuberances whereby the composition is indicated, making their appearance subsequently. I have not been able to follow at sufficiently early periods the formation of the septum, of which I do not see any notice has been taken. It is complete even

before the corolla has forced upon the calyx. Towards the apex of the ovary it presents on either face a bulging along the central line (*a.* Pl. 39.—Fig. 7.) which is transparent. This structure which exists in a species of Bignonia allied to, or the same as B. suberosa, Roxb. shews perhaps that the structure of Eccremocarpus is the typical structure of the family. If the placental septum, however, be really compound, as the transparent line would indicate, I should consider the structure as analogous to that of some Cyrtandraceæ, the ovula being limited to the outermost part of the lamelliform placentæ. The opaque part of the septum appears a direct continuation of the placentæ. It is a representation of cruciferous fruit with the exception of being dicarpellar. I very much doubt the propriety of making this a distinct genus, it has the fruit of Spathodea, which is itself scarcely distinct, and other species of Bignonia are extremely like this.

Limnanthes Douglasii.

Cal. 5-partitus foliaceus, laciniis suberectis æstivatione valvatis, persistens ; (these parts are not uncommonly 6.)

Pet. 5 sepalis alterna, obovata, emarginata, biloba, hypogyna, (long persisting in a withered patent or reflexed state.) venis pluribus, sub-simplicibus, luteis $\frac{1}{3}$-apicem versus albis.

Stam. 10, 5 exteriora sepalis oppositis, paullo longiora, filamentis subulatis. Glandulis 5, petalis oppositis subbilobis ad basim filamentorum breviorum.

Antheris medio affixis, extrorsis, biloculo-longitudinaliter dehiscentibus.

Pollen glabrum, immersu sub. 3-gonum, angulis truncatis. (A long furrow or elevated line is visible along the plane faces of the longer diameter, or is this the intine ?) siccum hippocrepidiforme ? (has it four or three pores ? and does that, or do those of the upper angle, give exit to the intine ?) Pl. 34.—Fig. 20. *a.* pollen fresh, *b.* ditto dry, *c.* ditto in water.

Ovaria 5 supera, sepalis opposita evenia ! ovulum unicum erectum raphe ad *interius latus.* Pl. 34.—Fig. 20. *d.* raphe ; *e.* 3 ovary ; *f.* ovule.

Stylus subcylindricus e toro in centro ovariorum quasi

oriens, sulcis indistinctis tot quot stigmata, apice 5-divisus. Stigmata, 5, punctiformi-capitata, quodque vasorum fasciculis 3. Ovulum solidum, Raphe simplici.

Carpella oblonga, rugosa, calyce patenti immutato cincta, armata stylo persistente, (divisionibus tantum lapsis). Pericarpium subsucculentum.

Semen anatropum conforme erectum, testâ carnosiusculâ embryonario sacculo membranaceo. Album. 0. Embryo viride. Cotyledonæ magnæ raphi parallelæ. Pl. 34.—Fig. 20. *g.* raphe, *h.* axis.

Radicula brevis, conica, hilum spectans.

I do not see any true perigynism in the genus, and it is well worthy of enquiry what are the limits of the application of this term; for in this case, and if I remember rightly in some others, it is merely applied because the base of the calyx is flat; true perigynism, may perhaps be limited to such insertions as are above the plane of the exsertion or origin of the calyx. Escholtzia is a manifest instance in point, and I know others proving that the torus may frequently be dilated before the exsertion of the parts constituting the perianth.

[Why should not the process of dilatation of a Composita take place in a simple flower?] The style has 5 vascular fascicles, the ovaries are veinless, the 5 vascular bundles divide above, each branch of the style having 2, the third and longest vascular-looking line being the ventral suture, the vessels supplying the ovule give off near their entrance into the ovule a branch which runs up the style.

[The venation of the style is certainly Brunonian? Consequently the five primary vessels correspond to the sinuses between the lobes of the ovary, an unheard of case.]

The ovules have no distinction of integuments.

This Brunonian venation at once led to the enquiry whether the carpellary leaves and the styles might not really be bipartite basin usque, the styles and branches contracting an adhesion with each other. This supposition would however imply a dimidiation of one carpel, the number being five, but this I do not find to be the case. This instance I consider analogous to the venation of the corolla of *Compositæ;* it at

once explains the necessity of the peculiar venation of the styles, and the evascularity of the lamina, there being no recurrent vein.

In *Gilia tricolor* Loudon's Annual, the stigmatic surfaces are confined to the inner surfaces of the divisions of the styles, or of the styles themselves, the ovarium has three dorsal veins which are continued up the styles, and three others which run up the line of union of the carpellary leaves, and terminate about the apices of the placentæ.

In *Linaria triphylla*, Loudon's Annual, there are several veins to the carpellary leaves, the dorsal is the largest, anastomosing, and continued into the style; the anterior vessel of the style the smaller stigma punctiformi-capitatum. Placentary vessel ends by anastomosing with the dorsal vessels of either carpellary leaf.

In *Rhinacanthus*, the stigma is simple, the surface occupying whole of the inner face of the divisions of the style, and produced upwards above it; the termination of the style is here marked enough. Ovarial vessels about four, of which the most lateral ones supply the placentæ, only the dorsal one alone is prolonged into the style.

In *Acanthacea*, alia, the same conformation occurs, but the limits of the style are less distinct; the lobes of the stigma are equal, the ovarial leaf about three-veined, the two lateral ones supplying the placentæ.

In *Alyssum*, the disposition of the vessels is curious, the 2 larger bundles of the 4, are perfect, they are anterior and posterior, and to them, the funicles are attached, and from them they derive their vessels, the 2 smaller bundles are simple, and are continued up the style as far as the larger bundles. I find also that the placental vessels are the earliest developed, and that they may be nearly perfected almost before the appearance of the smaller ones. The analogy of other venation would lead me to suspect that in this plant the ovula really arise from the midribs of the carpellary leaves. Other vessels subsequently appear in the lamina? Curious appearance of the septa occur, as if traversed by irregular cyclose vessels, the cellular tissue is also curious.

Cheiranthus.—In this the number of vessels is the same as in *Alyssum*, but in an early stage at least the dorsal vessel is most developed, or nearly as much as in Alyssum, the lamina becomes afterwards very veiny. The septum is in the direction of the axis, consequently the carpellary leaves are right and left.

It is obvious enough with regard to *Cruciferæ*, that the apparent opposition of the stigmata to the placenta may arise from cohesion between the stigmatic surfaces, of such a nature that the usual sinus of distinction be quite obliterated. These plants furnish the only instance I know of in which the placentary vessels are the largest, and send up the chief supplies for the style. The subject is obscured by the nature of the placental vessels; it is obvious that if the placental margins of a leaf furnished with a midrib be vascular, at least 3 vascular cords must exist in the carpellary leaf; now in these I only find two, and these are not disposed to separate.

The glands opposed to the shorter stamina are inside; while those which are sub-opposed to the longer, are *outside*, hence there are 3 series of stamina; it is most curious that the innermost should be the most developed.

If the placentæ of these plants be marginal, as I can scarcely doubt, the carpellary leaves have a right and left position.

In *Thunbergia*, including *Meyenia*, etc. we have every variety of cohesion. In *T. alata* the dilated parts of the style are equal, and the stigmatic surface is confined, as in all the others to the upper margin!

In *Meyenia Hawtayneana*, the lobes are rather unequal, each lobe is bilobed divaricately, and a good sized sinus exists in the upper; opposite the end of the style which is marked by a mucro, it is singular that the stigmatic surface of the upper lip is confined to the margin of each lobe, while that of the lower occupies all the margin, except the outer. [This I doubt.]

In the yellow *Thunbergia*, the stigmatic surfaces are distant; the upper division of the style is sub-involute, the

lower is cup-shaped; in both the stigmatic surface is confined to the upper margin.

In *T. grandiflora*, the lobes are united, and the stigmatic surfaces are confined to the margin of the funnel; a plicature exists along the line of union of the lobes.

Why the stigmatic line of the *Meyenia's* upper lip is interrupted, I cannot determine. See Pl. 28—Fig. 4.

In all these the style has two vascular bundles, which are anterior and posterior. The limitation of the stigmatic surface to the line is curious, particularly as it is coupled with a similarity in the texture of the outer and inner surfaces of the dilated portions of the style, although perhaps the inner is the more humid of the two.

As in these the inner surface of the dilatation is manifestly continuous with the canal communicating with the placentæ, it is pretty clear that the functions of the stigmatic surfaces are different, inasmuch as penetration can scarcely take place.

Another thing is remarkable, that the stigmatic surface does not run down the margins of the division of the lobes, but is distinctly limited to the upper rim of the dilatation. It will be curious if it be found that the stigmatic surface in no case runs down a line of separation.

Linaria purpurea of Seharunpoor, has a bicrurate apex to the style, with a double obtuse mammilliform mucro in the centre of the sinus; it is analogous to *Meyenia.* The vascular fasciculæ are anterior and posterior; the apex of each style is the mammilla: this is instructive, as proving that the ends of each dilatation of each style may gradually become stigmatic, and that the stigmatic surface need not be confined to the margin or to the interior surface, for here it occupies half the upper portion of each crus entirely. No abrupt demarcation between the stigmatic surface and style is visible.

In *Viola*, only one stigmatic point is developed; this is a circular opening communicating freely with the stigmatic canal in which the pollen tubes are at the proper place to be easily seen entering the ovula. The other stigmata are

indicated by 2 lobes, and these occupy the great bulk of the clavate portion of the style.

The ovarial vessels are curiously disposed, the axis of the anticous carpellary leaf, that which has the stigma has one vascular bundle, which terminates below the stigmatic point in a clavate, perhaps subradiate head. The axes of the other leaves have no vessels. The placental medial line of all three has one vessel, and subsequently, lateral vessels would seem to appear in each carpellary lamina.

Now although this shews that there is a relation between the perfection of the stigma and possession of vascular supply, and also that the lamina of a carpellary leaf may have no vessels; yet it does not disprove the rule that when there is one vessel, it occupies the axis of the leaf.

Papaver. On the assumption of the adhesion between the placentæ of each cell with the right and left hand placentæ of their neighbours, and which is of very frequent occurrence, Papaver is easily explainable. The pistillum consists of a number of wedge-shaped carpellary leaves, the inflected margins of which cohere with those on either side of them, and which do not meet in the axis; a line dropped from the apex of the wedge falls into the space between the two placentæ, whereas if the stigmata were in common parallism opposed to the placentæ, it would fall on the line of their axes.

The chief remarkable thing in Papaver, is the great size of its placentæ, for I do not consider them septa from the consideration of other genera of the order, and from their structure, which is entirely that of placentæ, presenting no especial lines of venation? and also because of the direction of the development of the ovula, which in all cases is greatest towards the point of union of the involute margins; whereas in *Papaver*, the extreme margin, which, if these were septa, would correspond to the line of cohesion, is destitute of ovula. It is a good instance of *a cruciferous septum*.

Nor must I omit the membranous appendage of the outer end of the stigmata, the sinuses of whose lobes correspond

to the axes of each carpellary leaf, and which is of a late development.

In the earlier stages, the vascular fascicles are limited to the line of union of the carpellary leaves supplying the placentæ, subsequently the axis of each leaf presents a smaller one. I believe myself that the fascicles of the axes of the carpellary leaves are recurrent, for I find that those of the axes of the placenta on arriving at the base of the stigmata become a good deal diminished, and that branches pass off which form the middle vein, the direction of the few branches of which, is downwards. I have not ascertained satisfactorily its termination, but similar peculiarities of a recurrent vein occur in Compositæ. In all cases of venation the first process is the lining out of the direction, this takes place some time before any extension of the vessels into the transparent tissue. I find in the young ovary that they are really recurrent veins. I consider this as a proof of my position, that there is nothing anomalous in the structure and relation of the stigmata to the placentæ in Papaver.

Nigella. In this the carpellary leaves are reduced almost to their simplest form; they are very leafy, the stigmatic surface is a mere humid line, the continuation of the ventral suture; it terminates just within the apex of the style, and is spiral from the twisting of the style. Pl. 34.—Fig. 21.

The carpellary leaf is excessively vascular; independently of the main dorsal vein, the placenta is freely supplied, and so is the style with several, indeed many fascicles; the placental and dorsal fascicles are connected by the transverse veins. Are the placental vessels recurrent here? Why should not the cellular bodies or the pistilla in this grow, they are like gemmæ?

The androphore, opposite to the exsertion of the nectaria produces no stamina, these originate in simple oblique series of five or six filaments.

Although the nectaria are reducible barely to the type of a single anther, the curious disposition of the filaments asks, are they not compound? I find there are 3 approximated vascular fascicles, of which the central is the smaller.

Nasturtium, has several fascicles to the carpellary leaf. [What relation is there between the venation of the leaf and of the carpellary leaf?]

Platystemon. In this the carpella scarcely meet in the axis, nor do their margins seem to cohere with each other. These margins are obviously continuous with the stigmatic surfaces. The ovarial vessels are, a dorsal one subsequently ramified laterally, and marginal ones (one on each side,) these anastomose at the base of the style with the dorsal vein. The ovula foramina look downwards. This instance is curious, as shewing a sort of speciality in the independence of the placental or marginal vessels from the dorsal. It may be remarked of Platystemon that it is more Papaveracious than Ranunculacious, it has the habit; and precisely the calyx, together with the sudden transition to corolla of Papaver. Venation sub-monocotyledonous and lax tissue, with ternary envelopes.

Punica. Of the original simple composition of the pistillum in this, and the correspondence of the cells with the divisions of the stigma, I can speak with tolerable confidence. The obscuring phenomena are of later date, and never affect the composition of the style.

They consist first of the production of cells, about four within the others and round the axis.

If the outer cells be 8, there are 4 inner cells, placed alternate, with four of the outer; a line drawn through the septa of these will cut the inner ones into *two*.

Of the nature of these I am quite ignorant, they can scarcely be additional carpellary leaves, or they would affect the composition of the style, and there is no known instance of an addition to the originally formed number of carpellary leaves.

The basal cells communicate with the stigmatic canal.

The later development of the interior cells appears to me singularly opposed to Dr. Lindley's remarks, that the carpels are in two rows, one above the other, in consequence of the contraction of the tube of the calyx, from which they arise.

[Vide Int. p. 44.]

Escholtzia appears to shew that a bicarpellary structure may, as has been suggested by Lindley, really arise from a quadri-carpellary, two being abortive; the two smaller placentæ which are stigmatic, are very variable in size, having however distinct vascular axes, the number of vascular bundles of the others being 5 or 7; one dorsal, two marginal or placental, two intermediate.

In such cases as these, appeal to the state of the early flower will settle the question; the nearer we revert to the origin, the more equal will be the styles.

It is singular that though there is an unusual tendency to costation in the veins of the fertile lamina, in the abortive one, nothing of the sort is detectible, although a transverse section still shews a line of demarcation between the two.

No instance can be more instructive of the nature of the petals and stamens, as opposed to the sepals and carpella.

These form a leafy, the others a glandular structure. See Pl. 38.—Fig. 4, C. *e*, Petal; *d*, stamens; *f*, dilated end and lip of torus.

The ovula are fixed along the line of union of the two carpels; the inner surface of the barren produces hairs, and also ovula. Pl. 38—Fig. 4, B. The distinction between the carpels subsequently becomes less. The ovules certainly appear attached to the barren carpels, although towards its margin the remainder produces hairs. Pl. 38—Fig. 4, *a*. Barren ? carpel.

In *Escholtzia* the stigmatic surface is plainly traceable to the upper part of the placentæ.

At a very eary stage the base of the perianth and stamina are on a level with the base of the ovary.

In Linum trigynum, the styles are, as the name implies, 3 in number, each terminated by a capitate stigma with a sinus pointing outwards, each style has 3 vessels which terminate the sinus.

The ovarium has 3 vessels which are continued into the style, and 6 cells, 3 of which are derived from the dorsum of the lamina. At an early stage these spurious septa are

much smaller than the true ones, subsequently they all assume nearly the same size.

The existence of sinuses in all simple stigmata is irreconcilable with the hypothesis of the stigma being the apex of the midrib, whereas it is easily explainable by the hypothesis of the stigma being derived from margins of the carpellary leaf.

In a true normal simple stigma, the sinuses will be two ; one will exist at the point where the stigmatic surface passes into the stigmatic canal, another opposite the termination of the midrib of the carpellary leaf. The existence of a mucro in this direction, shewing the point of the leaf, is subversive of the same hypothesis.

Among theoretical objections to this, I might mention that if the stigma be the apex of the midrib, it can in no case form a direct communication with the stigmatic canal, which is nothing more than the space between the cohering margins of the leaf, and its dorsal vein. And in all cases of penetration of the pollen tubes passed down in the direction of the origin of the stigma, they would meet with the hardest, instead of the softest tissue of the structure. This however, would be a theoretical, rather than a practical objection, since there are reasons for supposing that in some cases no actual penetration takes place, the tubes after having been excited by the stigmatic tissue, passing down directly into the stigmatic canal, as in Thunbergia, Viola, etc. in which the end of the stigmatic canal is plainly open.

In Dr. Lindley's prefatory remarks to the Illustration* of Orchideæ, it is positively allowed, from the consideration of Orobancheæ, that placentæ may arise as well from the axes as from the margins of carpels.

Lindley says that the analogies to costæ of Orchideous carpels may be regarded as the united margins of the carpels, or as imperfect carpels, attributing therefore axile placentæ to this family.

Mr. Brown's explanation of the structure of that family is partly attributed to his supposing "in common with all

* Genera and species of Orchid.

other Botanists at that time, that placentæ must necessarily alternate with the stigmata."

The explanation of an Orchideous stigma is very complex, see Irideæ for a two-lobed style, and I may observe that the lobed condition of the web connecting the fertile arms is not a proof of its being of a double nature in the sense Dr. L. means, this will be quite evident from the structure of Meyenia.

April, 19*th*, 1841. In Plumeria I find the same essential occurrences in the evolution. The same fashioning out of the sepals, petals and stamina from a shining capitate termination of the axes of the branches of the inflorescence. The same posterior appearance of the Pistillum in the centre of the depressed disk, in the shape of an elevated rim sloping in the direction of the line of subsequent union of the two.

At one period the young flower, petals and stamina represent a button with a flattish disk, and a raised 10 lobed border: the alternate lobes representing the stamina being smaller and rather interiorly situated. The spaces between the petals are a good deal larger than in Calotropis, and hence the less interior situation of the stamina.

I also find that even in the very young states, the divisions between the petals do not reach to the place of the base of the sepals, but this I am rather disposed to attribute to a slight elongation of the axis between the two whorls, than to the union of the petals among each other.

The Pistillum in its young stages obviously represents a leaf folded inwards with thick margins; and from these margins when still more inflected do the placentæ arise.

With regard to the pollen, the steps are also almost precisely similar, there is the same original continuity, the same appearance of grumous matter in the situation of the cells, the same occupation of the cells subsequently by a consistent homogeneous grumous mass, then by a grumous mass cellularly subdivided, then by a more cellular mass containing nuclei, the same subdivision of these, (two being also a common number, when three, either all equal, or one

hemispherical, in the two others quadrispherical), the same spheroidity of the young grains on their escape, the same development of the folds, and when these appear complete, of amylacious granules, the same disappearance of the nucellar granular matter as the grains develope.

Parent cells breaking upon pressure are divided into as many cells as there are nucelles.

In *Lindenbergia* the corolla is developed in precisely the same manner from a smooth shining disc, occupying the calyx: this body is precisely like that found in the axils of the very young leaves. The stamina are at first like all others, but as soon as they are quadrilocular, the cells appear to grow by their lower ends, thus becoming detached as it were from the filament.

Corolla included in the calyx, green; tube equalling in length the lacineæ, very fleshy. Pl. 39.—Fig. 3. *d*, thickened margin.

Stamina nearly sessile; i. e. no filament, hypogynous; quadrilocular cells occupied by a linear cylindrical grumous cohering mass, presenting indications of cellular sub-division. Pl. 39.—Fig. 3. *a* stigmatic line, *b* inflexion; *c* very young pistil.

The placentæ in this last are obviously continuations of the inflexed margin. Stigmatic line is traced out, it is linear stigmatic, concave, extending as far as the style, or petals, the spaces between which are tolerably wide. No trace of an ovary at this period.

Just as the corolla pushes out from the calyx, the cells are filled with a grumous opaquish mass; the walls of the cells themselves are similarly coloured and opaque, and irregular, as if torn.

The young flower at one time looks exactly like a button with raised lobed edges, the lobes which are to become the future stamina are only just internal to the others.

The separation of the young grains takes place just when the corolla is about emerging from the calyx; the grains are quite transparent. The divisions are 2, 3, 4, generally 3, but 2 are not uncommon.

The three are either equal, or else a modification of 2, one nucleus divided into 2 nucelles.

The grains as nuclei in the parent cell, are just appreciately granular. On becoming free from restraint they assume a spherical form, and begin to develop pores, or in one and the same anther interruptions of the outer thick coat. The grains assume an angular form in the folds, angles bifid, part of the process of developing coats.

Calotropis.—The same mode of development obtains as in Calotropis. When the calyx is very minute, its centre will be observed occupied by a shining disc, obscurely pentangular, the angles alternating with the sepals. The æstivation is determined equally early. The largest sepal is in the axil of a *bract!* [Pl. 39.—Fig. 2, *a*, did not occupy this line on the other side, *b*,—*i* disc; *c*, æstivation; *d*. transparent grumous near the midrid.]

The anthers in the earliest stages are thick, oblong, cellular bodies, occupying the sinuses of the petals, which last are mere cellular scales.

Pressure demonstrates even at this very early period, four lines of grumous semi-opaque matter, continuous with the indistinct cells of the general substance; the two outer are marginal, and twice as broad as the inner; the whole present a general tendency to confluence at the apex. Pressure does not cause any separation.

In a very young stage the corolla is monopetalous, the divisions however reach nearly to the base.

When they are under a piece of glass, $\frac{1}{20}$ represents them as entirely cellular, the grume is confined to a broadish irregularly defined line on either side of the connectivum, passing gradually into the general cellular undefined substance. The connectif is traced out, and the grume curves out at the base of the anther.

Pressure causes the discharge of a little fluid, in which under $\frac{1}{20}$ there is an appearance of cellular substance, but indistinct, in a crowd of minute granular matter. There are traces imaginable also of four obscure cavities left by the discharge of the above matter. Pl. 39.—Fig. 3, *f*, *g*.

Ovaria distinct lamina; with very thick margins, meeting in the centre of the style and forming an oblong process: all cellular. Pl. 39.—Fig. 3. *a*, to *h*.

The young grains on their escape seem to be provided with an inner membrane, which is filled with the granules.

The interruptions of the outer coat are at first very slight, but then they become very pronounced, at the same time that the spaces falling between appear to assume a flattened form: hence the angular appearance.

After the outer coats are completed the grains re-assume a spherical form, the inside appears irregularly grumous, and then decided granules are developed: these are the three particles; the degrees and rapidity of the action of iodine on these depends upon the amount of development, for the grumous stage remains fuscescent when the more developed are quite violet.

The pollen grains, when the corolla is ⅔ longer than the calyx, will be found most spherical, 3 folds ? and 3 pores; either quite translucent or beginning to look mucilaginous from the development inside of granular matter. They are very unequal, the smaller ones being still angular, and as if shrivelled. These folds look much like interruptions of the membrane.

The prolonged action of iodine causes the inner to protrude almost entirely from the mass; it is not coloured itself, not even fuscescent.

Gmelina asiatica.—The stigmata appear very remarkable if viewed in connection with the usual structure in the allied families.

The stigmatic surface is excessively small, terminating each division of the common style; it is a marginal surface communicating with a large partial conducting canal, which runs into the common one just below the bifurcation.

Pl. 39.—Fig. 4. Only two flowers were examined, so that the result wants confirmation, particularly as very young flowers present no peculiarity.

In the Jamun *(Eugenia jambolana)* the stigma is punctiform, purely terminal.

The ovary is bilocular, yet the style has several fascicles of vessels.

The tube of the calyx presents no demarcations of structure, it is uniform, is very vascular, excessively so; possessing a number of fascicles in about two series.

A transverse section shews four vessels, at equal distances, two somewhat smaller.

[Poinciana. Same mode of development. The apex of inflorescence is an aggregate imbrication of cellular bracts with empty axils, exactly like the young flower buds which are found in the axils lower down, and which are cellular, convex, quite entire bodies. Pl. 38.—Figs. 1. and 2.

Anterior fornicate sepal developed first, before any trace of the others appears, and it always preserves its increased development. The petals are equal until a tolerably late period, when the vexillum is found smaller. Stam. sepalis opposita, are most developed, having their anthers quadrilocular, when the others are mere scales. Pistil a convolute leaf, involute towards vexillum or towards axis. *a.* Stam. pet. oppos.; *b.* pet. *c.* Stam. sepals oppos.

Ovula of latish appearance, marginal.

Mass (*a.* Pl. 38.—Fig. 2.) very distinct, a grumous mucilaginous one containing parent cells, with a large thick hyaline disk, and 3-4 nucelles grumous, in a greater or smaller state of separation. The outer edge of the mass is most developed, innermost grumous, here and there *dances* of granular matter. Pl. 38.—Fig. 2. *b. c.* unequal development the nucelles before escape. *d.*—. A favourable instance for examination, the granular appearance of the nucelles seems perpetuated.]

In Villarsia grandiflora, the parent cells are hyaline, each nucelle is distinctly contained in a separate cell; indeed the apparatus looks as if 3-4 grumous nucelles were imbedded in a roundish or oblong mucilaginous transparent body, so thick are the partitions, so thick the margin of the disc, or rather the spaces between the nucelles and the circumference. Pl. 29.—Fig. 8. *a, b, c, d.*

At this period the nucelles are easily separable, they now retain the shape resulting from their confinement, they

are minutely and slightly granular. The mass is quite free from the cell, and is as usual enveloped in grumous amorphous matter. Pl. 29.—Fig. 8. *e.*

A little earlier, and the mother cells present a nucleus only, no aggregation into groups ; the mother cell is of a fine blueish-colour, the disc tinged fleshy; it looks just like the membranes, for the granules do not reach the margin of the inner disc. Pl. 29.—Fig. 8. *f. g. h.*

The parent cells are now become hyaline blueish, scarcely separable although distinctly marked out, containing an irregular grumous nucleus. Pl. 29.—Fig. 8. *i. j.*

Nucelles separated into young grains, with a simple edge and granular disc ; mass still slightly coherent at the circumference. Pl. 29.—Fig. 8. *m.*

The grumous mass conforms to the shape of the cell, and shews traces of cellular sub-division. Pl. 29.—Fig. 8. *l. k.*

Cactus. Quadrilocularity 1st developed, tissue of nearest anther quite continuous ; pressure causes the escape of a little grumous fluid. (Pl. 38.—Fig. 3.) Less developed anthers cells contain a coriform grumous mass, with faint traces of cellularity. Those immersed in the mass as it were, appear to be the parent cells : membrane hyaline, not very distinct, large grumous nucleus. Grumous mucilaginous matter, with many subcelluliform bodies. The stigmatic canal of the perfect flower is highly developed ; it presents 6 angles and as many deep sinuses ; vascular fasciculi 6 ; opposite the angles.

Points worth examining—Non-correspondence of ovuliferous lines with stigmata, irregularity of ovula, identity of the whole inner surface of the ovary.

In *Cruciferæ* there are traces in the very young state of 4 involutions of leaves, these are pretty equal, but the two which subsequently become the stigmatiferous, are rather the latest. See *a, b, c, d.* Pl. 29.—Fig. 7.

When the flower bud is half developed, there are but obscure indications of the limits of these 4 on a transverse section. The venation is 1 dorsal, 2 approximate placentigerous. During expansion however, the limits on a transverse section (A) are evident, the placenta appears a grumous

mass interposed between the two sterile carpella, and the fact of the endocarp (which is very cellular, hyaline, and thick) not entering into the formation, is still more distinct.

Externally the limits are always distinct, the barren carpella *g*, being marked out by a line, expanding above into the styles, the fertile *h*, by a rim, which becomes more marked subsequently, see Pl. 29.—Fig. 7. *e f* young, *g* barren, *h* fertile rim.

I am aware that an explanation offers itself, by merely assuming the placenta to be the line of union between the 2 carpells, but this will require the lowest part of the sinus of the stigmata to correspond to the apex of the style, which is contrary to analogy as well as of venation. The stigmata as they are, so obviously correspond to their proper situation, that I am willing to look elsewhere for an explanation. I have not been able to make sufficiently extended observations with very young pistillums. But if my supposition be correct, that it is quadri-carpellary, it is a proof that ovuligerous carpella may exist without any obvious lamina. It also bears on Orchideæ, but is against analogy, since in Cruciferæ and Escholtzia, it is the stigma-bearing carpella that bears exclusively the ovula. And it is probable from the consideration of Escholtzia, that the imperfection of its stigmata of the fertile carpella is connected with the presence of ovula or those with perfect stigmata. Neither must I omit adverting to the probability of the growth of the septum, which is an extension from the placenta, being attributable to the want of the usual development of the lamina? In Sinapideous fruits there are obvious traces of four additional component parts, which may be considered as the styles of the laminary carpella. See *i*. Pl. 29.—Fig. 7. [?*j*. *k*.]

To this structure Escholtzia may be considered as presenting a transition, although precisely in the opposite direction; in that genus there are 4 stigmata, 2 perfect, and 2 abortive, corresponding to which are 2 abortive carpella bearing the greater part of the ovula.

In drawing confirmation of this hypothesis from anomalous genera of the natural family, it must be borne in mind, that

the pistillum may be apparently 4 carpellary, and yet present no deviation from the ordinary type. It is in those cases alone in which the placentæ obviously relate to the margins of the leaves, that much stress is to be laid.

Cruciferæ are occasionally tri-carpellary, as an instance now before me of Sinapis venulosa testifies. The carpellary leaves were unequal, one being nearly twice as large as the other, the stigma corresponded : they were all united by their lower veins. The placentæ were 3, opposite the confluent parts of the stigma. Vide A. Pl. 30.—Fig. 2. The two smaller stigmata were formed each as it were from a demidation of the bigger, but it only shews that even in a 4 carpellary type, the real number will be 8 carpellary, [in this instance alternating with fertile, were 3 barren carpella marked out by veins.]

In this Sinapis when the carpels are two, the placentæ are undoubtedly attached along the apparent midrib, a line continued up the axis of the placentæ will pass through the apex of the style. Vide Pl. 30.—Fig. 1. *a*, *b*, placenta. *c*, lateral view. The vessels are about 4, the two larger terminate in a clavate manner within the apex, the two others are much smaller, and terminate about $\frac{2}{3}$ up the style.

See also *d*, *e*, *f*, *g*. Pl. 30.—Fig. 1.

Regarding explanations, several may be derived from Cordia, Escholtzia, etc.

In Pternandra cærulescens appearances are not altogether unfavourable to the supposition that there is a disturbance in the direction of the carpella, similar to that which affects many Boragineæ, and all Labiatæ, in which if ever polysporous placentæ be found to exist, they will, I am inclined to conjecture, be as they are in Pternandra, dorsal; the apex of the carpella being in the ordinary situation of the base.

But, as appears to me suggested by the situation of the raphe, the placenta has a tendency to be dorsal.

Hence such a complex explanation as the above may be objected to, when so easy a one as that of admitting the carpellary leaves or their dorsum, to occasionally bear ovula is

at hand, and favoured too perhaps in some measure by the source of the vascular supplies of the placenta.

I have however found most of the anomalous instances cited in favour of non-uniformity, to be so easily, and I think naturally explicable, particularly Orobancheæ, Papaveraceæ, and I hope Orchideæ and Cruciferæ, that I am disinclined to allow the possibility of such an instance except on the clearest proofs.

One thing is certain at any rate, from the evidence of P. cærulescens, that an ovarium inferum may have part of its cells and even placentæ and ovula superior to the plane or line which we were to draw, when we make use of the term ovarium inferum, which I am at present inclined to prefer to ovarium adherens.

The most legitimate mode of accounting for it, is by supposing some such depression of the vertex of the ovarium, as shall cause the placentæ to be forced outwards.

By supposing a change in the usual direction of the axis, by which ——* and this is perhaps countenanced by appearances in Pt. cærulescens, analogous to what occurs in Boragineæ and Labiatæ and by the disposition of the vessels, since the fascicles corresponding to the dorsal vein is towards the axis.

One of the consequences is the possibility of a disturbance in the ordinary relations of an ovarium inferum, so that the apex shall occupy the fundus, and the base be ovarium superum.

Pl. 28, Fig. 2, *a. b. c.*

[In Pternandra, the depression of the vertex of the ovarium suggests to me the probability of its being analogous to the obliquity or disturbance of direction in Boragineæ, Labiatæ and Ochnaceæ?

The vascular supplies are 4, just round the centre of axis, which I take to be composite *placentary vessels*. There is a large dorsal vessel, which *seems to supply* the placentæ,

* An interruption here occurs in the MS., but the blank seems to be supplied by the next paragraph but one, commencing between brackets.—Ed.

and which passes completely round the cell, then up into the style, in which it becomes the centre of 3, the compound placental vessels having divided?? Pl. 28.—Fig. 2. *d, d, d,* etc.

The objection to this is the fact of the placental vessels being given off from the main vessel below the lowest points of the placentæ.

But Ochnaceæ, Labiatæ, Boragineæ must again be examined.]

Swertia. Pl. 32.—Fig. 1.

The corolla of this is nearly polypetalous, indeed the stamina appear to be the chief bond of union, rather than the adhesion of the laciniæ themselves, the sinuses are evascular, *e. e.* normal carpella, *f. f.* additional ditto, its opposite one removed, *g.* solid substance serving as a base for the additional carpella.

Fig. *a. c.* normal carpella, *b.* two additional ones of outer series, both empty! *d. d.* four additional ones of inner series, ovuliferous.

The above sketches shew a great tendency both to the production of several carpella, as well as to their being arranged in a double series, of this *c.* is an instance. The ovule even of the most imperfect are a good deal developed as shewn, *c. a.*

The additional carpella are variable in situation, and very frequently they are not on the same plane.

[? Orchideæ. Pl. 32.—Figs. 2 and 3.

The order of development is as follows:—

Sepals.
Petals.
Fertile stamina.
Barren stamina, (2).
Stigmata of which the posticeous appears first.

Fig. III. The labellum is quite simple up to a late period, and parts hypogynous. The barren stamina belong to another series, because developed at a different period. The largest stigma is developed first, *a.* Fig. 2 anther; *b.* barren stimina; *c.* largest stigma, or disc of the three.

Fig. II.

a. 1 Posticious stigma, 2, lateral one.

b. 3 Abortive stamina.

c. At this period the carpellary leaves appear with 3 placentæ.

d. ———

e. { 1 Undeveloped stamen.
2 Lateral stigma. }

f. 1 Petal.

g., *h.*, *i.* } 2 Anthers { No lateral series, no stigmata at this period.

From this it is evident that the three additional costæ do not exist in the young ovarium, that the labellum in its younger stages is like the lateral petals, that the perfect anther or that of the outer series is formed first, it remains to be seen therefore which stigma appears first.

Consequently as regards the labellum, those Orchideæ are to be regarded as the least perfect in which this body is the least irregular.]

Melia, *Neem.*—Pl. 33.—Fig. 11. At first sight presents some analogy with Apocyneous stigmata, but the whole surface is secreting. The ring *a*, at the base, is latest formed, and is the most stigmatic. The vascularity of the style is obscure and limited. The stigmata are quite cellular.

Explanation of the Development of Pollen of Melia.—Pl. 27.—

Neem.

Series A.—Represents very young anthers, they are oblong stamina slightly curved inwards and excepting the margin, presenting a somewhat opaque turgidity, which disappears on slight pressure. No trace of quadrilocularity exists or even bilocularity. The tissue is continuous since nothing escapes upon pressure.

1. Outer view of two stamina.
2. Lateral view of a stamen.
3. Stamen under pressure, cells very indistinct, those of the margin less so. $\frac{1}{20}$.

*

Series B.—Stamina more developed, outline somewhat rhomboidal, with a deep fissure along the margins, the 4 loculi are marked out, those of the inner ones being the most turgid. The cellular tissue still indistinct, pressure causes the separation of an *amorphous* (in itself) grumous very minutely granular mass. (Amorphous is not a correct term, because it must have the form of the cavity containing it.) The opacity of the anther is greatest on either side of the connective, which now exists. The turgidity disappears on slight pressure, (whether from all the cells or only from the inner, or only from the outer I can't say.) As does the appearance of quadrilocularity.

1. Back view.
2. Inner ditto.
3. Portion of the grumous contents.

Series C.—The process of the filament ? now exists, and appears as if embracing in its axilla the stamen. The anther has now assumed its perfect figure, it is curved inwards, is distinctly cellular, and quadrilocular. The cells contain a mass of grumous fuscescent matter, composed of minute granules of different sizes, held together by a mucilaginous looking substance.

1. Back view of a stamen.
2. Lateral ditto.
3. Part of the contents of a cell.

Series D.—The process of the filament slightly 3-toothed, reaching one-third up the anther.

It is at this period that the chief changes occur. The grumous homogeneous contents of the cells of the former period, now present distinctly, traces of cellular subdivision.

Query. Is the cellular mass now existing, the grumous mass of before ; and are the nuclei now part of the grumous matter as it then existed ? Or is the cellular mass and its contents a new formation ?

Each division contains a conformable grumous nucleus, *a*, and is a distinct cell, at least I do not see a continuous membranous edge to the mass, which is however in some measure obscured by adhesion of grumous matter. The

grumous nuclei of each cellular sub-division of the mass, then present traces of 3, or very generally 4 nary division. I have not paid attention to the rates of development of the different cells. The transition is difficult to see, possibly from the quickness with which the change takes place.

1. Side view of anther.
2. Upper half of ditto, two masses seem protruding from the anterior cells.
3. Cellular mass, the cellular divisions very distinct, the summit is a single cell. The cells are sometimes of a fine bluish tint, like that of a solution of quinine in diluted sulphuric acid and water, the mass is still obscured often by adhering grumous tissue, which forms the superficies of the mass.
4. Anther mass, divisions still indistinct, but appreciable. From this and 3, I should say, that the nuclei of this stage did not form part of the original homogeneous mass.
5. Anther mass, cellularity much more evident, each division containing a grumous nucleus.
6. Cellularity still more distinct: as well as the nuclei which now appear more condensed.
7. Represents an entire mass: a single cell is seen to be interposed here and there; elsewhere 2 or 3 rows perhaps exist, the nuclei of the base, i. e. corresponding to the base of anther? are much the most developed.
8. Upper half of another mass.
9. Portion of anther, in which nuceller division has taken place.
10. One of the cellular divisions, its nucleus divided into 4 nucelles.

Series E.—Mass more developed, enveloped in grume, all cells quaternarily divided, 1.

Series F.—Process scarcely half up the anther.

The mass still possesses some cohesion; it appears a grumous body in which the cells lie imbedded in one and the same mass; these are to be seen in their former state, and in

the form of loose grains, although the outline of the parent cell is difficult of being distinguished, except towards the circumference and point? The nucelles have escaped from the parent cells, and have assumed a spherical form; they are the pollen grains.

The escaped nucelli are still grumous, but less so than when in the parent cells, this may arise from their greater size. The grains immediately begin developing sulci.

1. Lateral view of stamen.
2. Portion of mass.
3. 4. Nucelles and parent cell.
5. Nucelles just separating.
6. Ditto separated.
7. Two young pollen grains.

Series G.—Pollen grains, developing sulci, the first appearances are four or more thickenings of the membrane.

Series H.—Process nearly two-thirds up the anther. The mass in the circumference is still grumous and still presents some cohesion. The central consists of free pollen grains, which are larger than those imbedded in the grumous circumferential tissue. The young grains are now transparent membraneous, they present a variable but yet probably a definite number of thickened sulci, which in some points of view, look as if they radiated from both ends, until they nearly meet in the centre. All stages of formation may be seen, from the young simple grain, to one presenting 8 and 10 *sulci*.

1. Stamen.
2. Mass, presenting loose grains in the centre.
3. Presenting of the margin of the mass signified.
4.
5. } Grains at different degrees of development.
6.

Series I.—Pollen grains, with the complete number of pores and folds?

Series J.—Pollen grains developing their essential amylaceous granules; these are developed from the interior of the grain, and are acted upon by Iodine. None are formed before the folds and pores appear complete.

Series K.—Pollen grains nearly filled with granules: these are developed very irregularly from the inner surface; in some cases half of the cavity is filled when the other half has only commenced developing. Is this the case in nature?

Series L.—Perfect pollen grains in water; they are spherical, and are rendered opaque by the immense quantity of amylaceous granules they contain, presenting here and there pores, which are chiefly evident from the bulging out of the inner membrane. This is of extreme tenuity, and is scarcely demonstrable except by the production of mamilliform *boyaux*. When acted upon by Iodine it is so thin as not to present an uncoloured edge. The grains burst in water, discharging the greater part of the granules; when empty, they (its granules) appear flaccid cells with *sulci*.

The development in this instance presents, I believe, no singularity; it agrees step by step with that of Pardanthus.*

Many points have been left undetermined, but the stamina are too minute to be very favourable for investigation. I know nothing as to how the 2 loculi are formed, nothing of how the 4 are formed; from some appearances, I suspect that the two locelli of each are continuous at the upper end.

The development of the inner membrane has quite escaped my means of observation.

It presents proofs of original continuity of tissue.

It presents proofs of the separation of parts of that tissue, from, or in which the parent cells appear.

It presents proofs of the production of pollen grains by the division of the nuclei of the parent cells.

The directions of the development are striking enough. In the first place, we have a grumous mass appearing in a cellular one.

Then we have a cellular mass appearing in the grumous one, or at its expense, in its place.

Then each of these cellular divisions produce, or present a grumous mass.

Then these grumous masses become changed into 3, 4, cells, of this there is no doubt.

* Journ. As. Soc. Beng. 1836, Vol. V. p. 732.

Then, and lastly, these cells develope amylaceous granules.

Thus it is an oscillation between grumous and cellular formations, for even the amylaceous product appears to me little more than a higher development of grumous, both consisting of granular matter held together by an appreciable, but indefinable medium.

Iodine only acts in its peculiar way upon the creations of the inner membrane; it acts on all the other granular processes in the same way as on ordinary tissue, but in a much more intense manner. But of the universal presence of this granular matter in all new growths, I am strongly impressed. Doubtless it is from it that cellular tissue are produced. Its disappearance in the young grains as they develope, may in some measure be taken as evidence of their assisting in the formation of its *sulci?*

Points to be determined.

Original continuity of polleniferous mass.

Direction of development to be confirmed.

Quadrilocularity of anther.

How the septa are formed.

Is not the tube a torus.—

Remarkable formation.

1st. Separation or solution of continuity.

The formation of cells of grumous tissue.

The formation by these cells of grumous nuclei.

The division of these into nucelli.

Then the disappearance of the granules of these, as the grain increases until they are quite observed; then the re-development of more distinct ones and in much larger number. Ganges, April, 1841.

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*Development of the Pollen, and the ovula in Sisyrinchium. Pl. 40.**

When the perianth is ½ line long, the anthers are highly developed; but they are sessile. Each cell, of which there

* The plate in lithographing was erroneously entitled *Pardanthus Chinensis.*

are four, contains a grumous mass, easily detached, particularly by slight pressure from the cells. This mass presents faint traces of division into cells, the whole of which are occupied by grumous matter. Fig. 1.

Perianth $1\frac{1}{2}$ line long. Cellularity of the mass more developed, the cells are entirely occupied by grumous matter, and are surrounded, as indeed in the former case, by grumous matter, but the mass can scarcely be said to be enclosed as yet in a proper membrane. Fig. 2.

Perianth $1\frac{2}{3}$ line long. The mass is now orange-yellow externally, where alone it is grumous; traces of an enclosing cellular membrane are visible, but indistinctly. The cells above alluded to have become separated; they consist of a hyaline rather thick-looking membrane, enclosing a grumous nucleus generally of a globular form. The membrane itself is generally globular, but often somewhat attenuated at either end. Fig. 3.

Perianth 2 lines long. The mass is now very readily detached, and is enveloped in a membrane which presents indication of cellularity, and of the cells being filled with orange grumous matter. The cells remain the same, so far as the outer membrane is concerned, but the nucleus has become divided into 4, occasionally 3 portions; which, however, are not separated. The space is intermixed with much grumous orange matter, especially towards the circumference of the mass. The outer cell is often elongated, and has, I think, a tendency to elongation from immersion in water. Fig. 4.

A little later, and the divisions of the originally simple nucleus are more distinct, but no displacement has occurred.

Perianth $2\frac{2}{3}$ lines long. The mass remains much the same, but the cells have increased in size, and the divisions of the nucleus have undergone in many cases separation, they are easily detached from the cell. Each division, now a young grain of pollen, is contained in a distinct cell, which, however, does not separate with the grain, but remains attached to the interior of the original cell. The masses are oblong-ovate, flattened along their contiguous faces, and

open along the centre throughout the whole of their outer faces, they are papillose and reticulate ; they contain a hyaline sac, apparently empty, which bulges out somewhat through the chink mentioned above. Fig. 5.

Perianth 3 lines long. The mass remains much the same exteriorly, the envelope and grumous matter still being present, but this last is confined to the immediate neighbourhood of the envelope. The grains of pollen are now nearly perfectly formed. They vary much in size, are minutely reticulate, opaquish, and marked along one side with a transparent line—the remains of the chink mentioned above. They are but little acted on by protracted immersion, no traces of the originally enclosing cells are visible. Fig. 6.

Perianth 5 lines long. The grains remain of the same appearance, and are excessively unequal in size, the smaller ones being *probably?* abortive. The chink is nearly closed by the rolling in of the margins. They are now susceptible to the action of water: the lips of the chink expanding until at length they are widely separate. The living membrane is very distinct and bulges out considerably after protracted immersion in water, but it has no tendency to separate. Fig. 7, 8.

Perianth 6¼ lines long. Pollen perfectly formed, varying much in size, but all the grains undergoing the same change on immersion in water. The outer membrane is rapidly pushed back on immersion by the enlargement of the inner hyaline one, which is now nearly filled with granules, still it does not spontaneously separate, although slight traction or pressure is sufficient to insure this. Fig. 9.

At the time of expansion the granules vary in size, the most perfect being lanceolate. They are highly reticulate, and the chink is very visible. They are of an orange-yellow colour.

Immersion in water causes a sudden bulging out of the inner membrane, which at length pushes back, and finally off, the outer coat. It is filled with granules and soon bursts, the granules are active molicules. Fig. 10.

This is interesting as an instance of development of pollen from the ternary or quaternary division of an originally simple nucleus, as an instance of perfect and almost spontaneous

separation of the outer coat, and as pointing out the nature of the longitudinal furrow of such common occurrence in almost all grains of pollen.

With regard to the 1st point I must observe, that the formation of granules by a process of division was first noticed by Mr. Brown, in Tradescantia virginica. The steps of the process differing chiefly in the late period, at which the nuclei lose their original containing cells, and in their forming directly the grains of pollen, and not by the production of secondary nucleus. If I mistake not, but I quote from memory, it was subsequently observed by M. Mirbel; an account of his observations being contained in the supplement to his observations on Marchantia. It was likewise nearly discovered by M. Brongniart, at a period earlier than either of the above, and had this excellent botanist observed the pollen in younger states in those cases to which he alludes of the cellules containing an uncertain number of grains, it would no doubt not have escaped him. The formation by division is precisely similar to the formation of the sporules of Mosses and Jungermanniæ.

The deciduousness or easy separation of the outer coat of pollen grains was likewise first pointed out by Mr. Brown in Coniferæ, and subsequently in Asclepiadeæ, in which latter instance, Mr. Brown did me the honour of demonstrating it. In the instance examined, it is perhaps nearly at its maximum.

Nothing whatever is known of the nature of the furrow which I have mentioned as existing in the usual form of pollen. I consider it satisfactorily proved by this instance, which differs perhaps from all others, the inflected edges not becoming coherent. I consider it as a provision to allow of a certain degree of extension of the outer membrane, without endangering the rupture of this, particularly as in some pollen, it may be observed to dilate gradually, and in all it disappears at length on immersion in water. And it is owing to this, that it is difficult to say whether it favours the exit of the boyaux or not.*

* For the development of the pollen in another species of *Irideæ* namely Pardanthus chinensis, see Journal of the Asiatic Society of Bengal, 1836, p. 732.

The ovula, when the perianth is ½ line long, are mere extensions of the placenta of a rounded form, entirely cellular, and presenting no traces of coats. Pl. 40. C. Expansion—$\frac{1}{20}$.

Perianth 1½ line long. The funicle is tolerably long, and the ovula have commenced to become inverted, they are globular, with a conical obtuse apex, at the base of which there is an evident constriction. The same placenta gives instances of more advanced evolution—a second constriction but very faint, being visible near to, and below that mentioned. These two constrictions mark out the future coats and parts of the ovula, the concealed apex becoming the nucleus, the part enclosed between the two constrictions, the second coat, the remainder, the outer coat. Fig. 2.

Perianth 1⅔ line long. The second coat has began to extend upwards and to enclose the nucleus, but the outer scarcely commenced to do so. Fig. *3a*.

Perianth 2 lines long. The nucleus is now nearly ½ enclosed in the second coat, and this again is for the most part enclosed in the outer, but not by any upward growth of this, but apparently by an extension downwards of the inner or second coat. Fig. 4.

Perianth 3 lines long. The nucleus is nearly enclosed, but the second coat is as much extended as it was before; the outer coat is considerably enlarged, but chiefly downwards, or towards its base. Fig. 6*a*.

At the time of expansion, but before fæcundation, the nucleus is totally enclosed, it is ovate, of considerable size, and has a central discoloured spot, the site of the commencement of the future excavation: the second coat is lageniform. The mouth of the neck somewhat dilated, and projecting very slightly beyond the foramen. The raphe at this time has just entered the base of the outer coat: at 5 lines length of perianth it is not visible, at 8, it is nearly as long as the funicle. Fig. *a*, *b*, *b*, *b*, expansion, but before foundation.

I certainly agree with Mr. Brown, as to the marking out of the subsequent portions of the ovule by lines of constriction, and not as M. Mirbel supposes, by the growth upwards

of the second integument and nucleus, from the base of the cavity of the outer. Up to a latish period a vertical view shows no elongation of the outer coat upon the lower part of the second, see X. Fig. 7. It hence follows that the nucleus is the part first formed, and that it exists prior to any of the others.

In this I have not succeeded in demonstrating the membranous nature of the embryonary sac, although I have examined it shortly after its appearance, it is rendered opaque by brown grumous matter: it is developed from the base of the cavity of the nucleus, but subsequently communicates with the apex of this also. It is at this time very easily separable, even when the testa has commenced to become crustaceous: the sac is broken down entirely by pressure.

At the time of expansion the ovula are ascending, seated on stout funiculi, the raphe which runs through this, but has scarcely entered the ovula being uppermost or next the axis. The two coats are distinct, the outer one being thick, the opening of the second projecting a little beyond that of the first. The nucleus is solid, with a central discoloured nucellus, which points out the site of the excavation which is to be.—*Suddyah: July 2nd,* 1836.

Cynoglossum racemosum.—At the time of expansion the ovaria are completely inverted and the raphal side of the ovule is consequently turned outwards, the foramin inwards, and pointing to the base of the style. The stigmatic tissue is distinct and spreads out at the base of the style, forming a distinct communication with the interior of each ovary. The raphe is just commencing to enter the ovulum. The nucleus adheres intimately with the *only* coat, which is prolonged at its apex into a longish neck; sometime after, this neck is in immediate connection with the stigmatic tissue, and about this time the nucleus is evidently excavated towards its centre. A little after, this excavation will be found increased and lined by a *membrano-cellular* embryonary sac, at the apex of which the globula and rudiment of the

embryo will be found: whether this sac is developed from the apex or base of the excavation, I cannot say. At the period above alluded to, it adheres by both ends, but very slightly. The raphe at this time is nearly complete, consisting of three primary branches, the two lateral ones are, however, subsequently carried up, and it then becomes 3-partite. Towards the time of maturity the embryo will be found covered by two coats, the outer being the testa, the inner thin membrano-cellular, the embryonary sac; the cotyledons are alternate with the raphe. But long before this the ovaria have commenced to assume their natural position, and as it were to be pulled down. The raphe will then be found to be next the axis, which situation it preserves, although from the depression the ovaria are subsequently subjected to, it will be found somewhat lateral. This is a sure proof that in all Boragineæ the ovaria are inverted, the raphe being in all, in the earlier periods of development, external.

Pl. 31. *Cruciferæ.*—Note showing the parts of the flower and development of the ovule with reference to the remarks of Dr. Lindley. Introd. Nat. Ord. p. 14, ed. 1832.

My view of the structure in this order is, that it is Dodecandrous. The stamina being arranged in 3 series, of which the outermost is incomplete, the two lateral ones, or those opposite the lateral sepals being alone developed, but still smaller than the others which form the intermediate series, and which are consequently opposite the petals. The innermost is represented by 4 glands, evidently situated on the same plane, or forming a single verticil, and these are placed opposite the sepals, their natural situation; the two lateral ones being placed within the corresponding stamina. I attach considerable importance to the fact of the 2 stamina opposite the lateral sepals being invariably smaller, as it points out a tendency towards the total disappearance of the outer series. It will be seen that this view accords much

with Mr. Lindley's; particularly as regards the incompletion of the outer series.

With regard to the composition of the pistillum, I incline to Mr. Lindley's opinion. I think that there are evident traces of four stigmata, and consequently of as many styles: and these stigmata are so placed, namely opposite the sepals, that the idea of their forming, or being portions of two stigmata must be incorrect. If such were the case, the line of division of either, should be opposite the lateral sepals. I may here remark, that this opinion seems to me to derive considerable strength from the consideration of the form and structure of the style and its supply of vascular (?) fascicles: these are four—occupying the axis of the four angles. The centre is occupied by a transverse (?) opaque line: whether vascular or not, I am unable now to say. The number likewise of vascular fascicles occupying the axes of the component parts of the fruit are 4. If the placentiferous valves are portions of the sterile (right and left) valves, such would not be the case. Then taking into consideration the want of continuity of structure between the two, I think there is very little doubt of the accuracy of Mr. Lindley's theory.

The accompanying diagram (Pl. 30.—Fig. 7.) will explain further my ideas.

In Thlaspi I find traces, although obscure, of a quaternary division of the stigma, and as in the instance cited before, the divisions are opposite the sepals, a fact on which great stress is evidently to be laid. The alternation of the four larger stamens which are opposite the anterior and posterior sepals, is obscure, still the anticous and posticous stamina, which should be opposite the placenta, are evidently wanting; the smaller are as usual opposite the lateral sepals, while the glands instead of being opposite the sepals, are opposed to the petals. The larger stamina still seem to belong to the petals, some allowance being made for displacement; in this case the 5th series, or the second calycine one, is totally wanting. Thus probably,

Thlaspi is 16 androus. The following numbers refer to the series as I have supposed them.

1. Sepals,
2. Petals,
3. Two lateral developed,
4. Glands,
5. Wanting,
6. Developed but displaced,
7. Carpellary leaves.

The style has 4 vascular fascicles and an opaque line in the centre.

In another. Nasturtium? Notulæ 2, 187, 454, a similar arrangement takes place, but a gland exists opposite the anterior and posterior sepal, so that the outermost series may be said to be more complete. There is no trace of a 4 nary division of the stigma, still I assume it from the transverse sulcus visible on the surface of the stigma, dividing it into an anterior and posterior lobe; but I have not been able to ascertain the number of vascular fascicles of the style. The numbers refer as before:—

1. Sepals,
2. Petals,
3. two Glands, two stamens,
4. Glands,
5. Wanting,
6. Stamens,
7. Carpellary leaves.

Mogur: March 28th, 1836.

Monstrosity of Sinapis.—Pl. 35. The transformations are inverse, those next the apex of the axis being much the most developed; they are to some extent or other universal, varying in degree, those in which leaves are developed from the floral envelopes having the pistillum, when this is not much changed, generally empty, while those in which the envelopes and stamina are but little, if at all deranged, have the ovula all converted into leaves.

Towards the base of each axis of inflorescence the petals are converted into unguiculate leaves, not uncommonly se-

miterete; these leaves have their backs away from the axis: they are generally somewhat petaloid in colour.

The stamina in all the stages except those of complete transformation of the flower into a leafy branch, are much averse to change, although they would appear to be void of any efficiency of function; occasionally one or more disappear, and on those occasions in which I have found only four, those four have been opposite the petals. When the number is complete, they appear somewhat dislocated, the four not being exactly opposite to the petals; they vary in length, but very generally the two shortest are opposed to two sepals. In those flowers much transformed, the filaments appear pointed near the base, the basilar part being stout and fleshy, the remainder withering.

The pistillum undergoes two changes, it is either gradually converted into two leaves, in which case it is generally empty; or it is in itself unchanged, but with its contents quite changed. Every step of its dialysis is traceable, as well as of its structure, and the continuation of the stigmata with the placentæ; the separation of the carpellary leaves takes place from above downwards, and when complete, its leaves are opposite.

The axis is prolonged (at a farther change) beyond the base of its leaves, two other nearly opposite leaves being produced, and beyond these are buds of branches, aggregated together; when the transformation is complete, a more or less perfect branch is formed, and this may be effected without any dislocation of the floral envelopes, or much change in the staminæ; or the change and dislocation may be considerable; generally in this case the apex of the branch originally occupied by a flower, becomes occupied by a rosette aggregation of leaves.

The degree of change of the ovule may be ascertained by the appearance of the pistillum; if this is near its natural shape, the ovule will be found little, if at all changed, the change taking place from bottom to top? But when the pistillum is turgid, shortened and wrinkled, or rugose externally, the ovules will be found changed; the steps of their

change are not traceable in an early period; the changed ones are green, oblong, more or less hispid bodies, concave interiorly; the subsequent changes consist in their expansion and lobation; the back of each is away from the axis: owing to this and originally to their being transformed leaves, is due the almost invariable situation of the raphe which must, unless some tortion of the funicle takes place, be next the axis. The raphe represents the midrib of the leaf, or its primary vein.

This monstrosity teaches us several things, it shows a curious indisposition on the part of the stamina to become leaves, which from their near relation to petals in structure I should not have imagined would have existed. Even when changed they very often preserve some traces of their original structure, the limb being either oblique, or partly discoloured. The disappearance of the two short ones opposed to two sepals, may be taken as an indication together with their smaller size, that there is always a tendency to imperfection of the outer series.

It teaches us the conformation of the pistillum, and the continuity of the stigmata with the placentæ.

It teaches us the nature of the ovula, which are beyond doubt transformations of leaves, it teaches us the reason why the raphe is always next the axis. Although I have not traced each step of the changes, I have no doubt that the outer tegument is a leaf united along its margin, but always open to a greater or less extent at its apex. In this instance the direction of the leaf corresponds well with that of the outer tegument of the ovulum, no inversion can therefore be really said to take place in anatropous ovula, but the limb of the leaf is bent back on the funicle, with which its margins also cohere.

The reason why the inner tegument is not vascular is due to its less development, there is no reason, however, why exceptions should not exist, and if they do, the vascular fascicle supplying it will *be opposed to the raphe*, because leaves alternate.

An ovulum is therefore to all intents and purposes a bud, its coats are analogous to the tegument of a bud, and its nucleus to the apex of the axis.

Description of Pl. 35. Monstrosity of Sinapis.

1. Flower: changed.
2. Same: sepals reflexed; 2, *a.* portion alternates.
3. More changed. Petals removed, situation of pistillum sketched in, two longer stamina opposite to two petals.
4. Its pistillum opened; 4, *a.* front view of its changed ovule; 4, *b.* side view of ditto.
5. Flower about similarly changed; 5, *b.* portion alternates only 4 stamina all long, opposed to the petals; 5, *a.* pistillum, open at apex, continuation of stigmata with placental suture seen clearly.
6. Ovula of a pistillum, solid, scarcely any tendency to inverted edges.
7. Flower: more transformed; 7, *a.* one of its stamina showing the articulation; 7, *b.* total dialysis of pistillum and prolongation of axis; 7, *c.* aggregate ramuli of apex.
8. Pistillum little changed; 8, *a.* nearly perfect ovula from its base; 8, *c.* imperfect ditto; 8, *d.* ditto under pressure, rudiments of inner tegument seen at *a.*
9. Pistillum; 9, *a.* lateral view of same laid open, *a.* Placentæ; 9, *c.* leaf in situ, its back turned outwards; 9, *d.* another ovule changed; 9, *e.* ditto.
10. Ovula commencing change, lateral and inner; 10, *a.* another more advanced; 10, *b.* ditto ditto.

Pl. 36. Ovula of a species of Lonicera, exhibiting their metamorphosis into leaves, of which the outer coat alone exists; the nucleus is still visible in those instances in which the expansion of the teguments to a leaf is not quite completed.

Deformation in Melilotus.—In a monster variety of Melilotus, I find that there is a tendency to dialysis, and to regularity, the stamens are regular, alternately smaller. The petals are still unequal, margins of all are incurved; the

vexillum is the largest; the pistillum is resolved into a leaf folded inwards, that is, towards the axis, its margins generally entire, sometimes toothed, always somewhat thickened.

The veins are 3 anastomosing, one dorsal and two marginal. The edge of the margins are very cellular and papillose, this is continuous round the point of the leaf, with the same stratum of the midrib, but which is not papillose. The margins below frequently bear *ovula*, sometimes 4, evidently springing from the incurved or inner ⅔ of the thick margin. The ovules are either linear lanceolate, like a leaf with a white papillose flat margin, or their margins are incurved and thickened.

In which case their central vein is simple, otherwise it is branched sometimes on one side. In one instance the lower of 4 ovules, two on either side only represented a mere incurved folded veined leaf, the sinus producing a decurved stalk terminated by a head, in which two annuli, and a central prominent nucleus were evident enough. To the base of the stalk a branch proceeded from the vein, a very remarkable structure. [Curious variation occurs in the inflexion of these ovula.]

In one instance the stalk of the ovary had a sheathing base bearing in its axil a prolongation of the axis of inflorescence, a short spike of hairy bracts, each with a minute flower calyx tolerably formed; the petals and stamina were rudimentary and incomplete. From the margins of the dilated part, just above the bud, proceed *two stipulæ?* but much like the leaflets above.

These presented no great variety, one was incurved yet had anastomosing veins. The last was not stipellate, but continuous, from a broad base with the substance of the leaf, more like a tooth; it drew its vessel, however, from the placental fascicle. This proves that the legume is not a terminate leaf. The venation is curious, the dilated part below the stipulæ had only two veins, one central and one lateral, for a stipule; this on passing the stipula base, turned inwards to the central fascicle, touched it as it were, and then passed on distinct; the other stipule was supplied by an oblique vein

form the central fascicle, and from the same point was derived the lateral placental vein of that side.

Description of Plate, 42.—Fig. 1.

1. Flower of a deformed Melilotus.
2. Same laid open, pistillum removed, shews a tendency to regularity and incurvation of all the petals.
3. Lateral view of a flower more advanced.
4. Front do. do.
5. Another flower, margins of pistil dentate.
6. The same to shew the structure of the margins, and its greater papillosity than the midrib.
7. The same laid open, (in front.)
8. Pistillum with an ovulum, the other ovulum was incurved inside.
9. The outer ovulum, (on the side of carpel) a flat body with similar edges as pistil, a central vein, branched to upper margin.
10. The other and its side of the carpel.
11. Lateral view of ditto.
12. Front of ditto, its margins are thickened and incurved.
13. Another with 4 ovula, the fourth not seen from its being inside.
14. The other side of the same pistil near the ovule, lower one of different structure.
15. Front view of this. 16. Lateral view.
17. Ditto 1-20th shews the ovuliform structure of the head of the stalk, one vessel sending a small branch to the stalk, but not into it.

18, 19. Different views 1-20th of the same ovuliform body.

20. Pistillum very slightly open towards the apex, as happens in all cases when in other parts a good deal closed.

21, 22, 23, 24. Ovula, from much closed pistilla assuming their proper form, appear quite closed and simple, although the hollow inflation in the centre looks like a membranous sac.

25. Ovulum from two-thirds of a closed pistil, the elongated neck was continuous with the surface.

26. The neck of the same, 1-20th, cells very indistinctly developed.

The same continued. Plate 43—Fig. 1.

1. Pistillum with its petiole embracing the flower bud
2. The same, base of the petiole enlarged.
3. Base of the petiole with two stipules shewing the venation.
4. Front view of an ovule.
5. Upper ovuliform leaf, with
6. The third ovulum, the dotted lines refer them to their places.

Ganges: 1841.

Monstrosity of Melilotus Officinalis. Plate 43—Fig. 2.

I found this on a hill near Boulogne, A. D. 1831. It shews the metamorphosis of the ovarium into a leaf, bearing ovula on its margins, remarkably well. No. 2, presents an axis, the growth of which has not been arrested at the usual period.

1. Flower: legume much larger than natural.
2. Do. the axis of which has become elongated, the result is, two flowers proceeding from that which ought to have been the terminal one.
3. Flower, much deformed.

4, 5, 6. Petal, anther, and ovarium of the same.

7. Calyx and legume *re-converted* into a carpellary leaf.
8. Legume open along the edge or placentary margin.
9. Legume converted into a nearly expanded leaf; at the base of its pedicel, are the remains of the stamina; the margins of all these open legumes were very glandular, and of a red colour.

Deformation in a species of Goodyera. Plate 41.

In this curious instance, which occurred in a species of Goodyera, found growing in the Tea jungles of Tingri, and exclusively in one, out of the only two specimens gathered, the perianth was fully and perfectly developed in all its

points and parts. No change likewise occurred in the ovarium.

The column was remarkably altered, the whole of its posticous (or in the bud anticous) face being completely distinct, and existing in the form of a flat filament. The anther preserved its usual form. The stigma was completely reversed in situation, and occupied the inner surface of the cavity, in which the cells of the anther are immersed. It was completely ringent. From the base of this a very distinct stigmatic canal led into the ovarium.

The anterior face of the column was furnished with the usual processes, but there was no attempt at the formation of a rostellum, usually so very much developed.

Corresponding to this, there was no attempt at the formation of a gland. The pollinia had pretty nearly the real form, but the transition from the scale-like masses, all arched to the *caudicula* (?) throughout its whole extent, was perhaps more gradual.

This instance is valuable, as indicating the extent and site of the filament, and as proving that the gland is essentially a portion of, or production from, the stigma; perhaps limited to the existence of a rostellum. I take this to be quite corroborative of Mr. Brown's ideas on this point.

But the most remarkable circumstance perhaps is the transposition of parts to adapt them to a certain end. And this is effected by a process apparently much more simple and direct than that usually resorted to. For here we see that the most decidedly pollen-looking part of the polliniæ, their bases, are separated from the stigma by the corresponding part of the anticous faces of the cells of the anther only, and hence mere dehiscence is quite sufficient, or would appear to be, for securing impregnation. In the other and usual form, not only is the actual removal of the pollinia from the cells of the anther necessary, but the still greater obstacle exists in the extreme smallness of surface presented by the stigma, and which probably depends upon the intimate cohesion of part of the base of the labellum with it; and if this view be correct, the two pro-

cesses visible on their anterior faces, are perhaps referable to the labellum.

To this part, reasoning from the analogy of Pterygophyllum and Chrysobaphus, we certainly should refer them.

Description of Plate 41.

1. Bud.
2. Ditto lateral sepals removed.
3. Column and labellum of deformed flower, labellum bent back.
4. Labellum of deformed flower.
5. Front view of column.
6. Back ditto.
7. Pollenia and gland.
8. Gland.

9.* Long section of column and anther.

10.* Lateral view of column, anther removed.

11. Front view of deformed anther.
12. —?
13. Oblique view of deformed column, filament bent back.
14. Ditto ditto, filament *in sitû.*
15. Longish section of deformed column and anther.
16. Ditto of column, anther removed.
17. Pollenia of ditto, front view.
18. Lower portion of ditto shewing no tendency to produce a gland.

Rangagurrah : February 25th, 1836.

* * These figures are omitted on the original drawing.

ON THE OVULUM OF FLOWERING, OR PHÆNOGAMOUS PLANTS.*

1. Description of the ovulum in its various stages of development, up to the period of fecundation.
2. Description of the same organ, from the period of fecundation to its perfection as the seed.
3. Detailed description of component parts, testa, raphe et tegmen—Nucleary membrane—Embryonary sac—Albumen—Embryo—Views of authors with regard to the coats, etc. to be noticed in their respective places, as well as anomalies.
4. Description of the mode of fecundation, prefaced by an outline of formation of pollen—Changes consequent on stigmatic action on the pollen—On the stigma, etc. by pollenic action—Course of the tubes: mode of application to ovula—Views of late Authors—anomalies—Adaptation of means to ends.

Memoranda.

[N.B.—With reference to the agency of insects.

In Asclepiadeæ and Orchideæ it might be said, particularly with reference to the admirable means of adaptation known to Botanists, that nature had been rather clumsy.

Instances of adaptation—Valisneria—subsequent development of anthers as in Parnassia, Asclepiadeæ, and Orchideæ, —notice Nuphar, Berberis, and every other available instance divisible into those in which the whole male flower is brought into contact with the female, and those in which parts of different flowers are brought into contact.

* Papers on the ovulum p. 133 to p. 181 partake of the character of private memoranda intended for the author's own use. They are now printed for the purpose of preserving them, and not as exhibiting his complete views on the subject to which they refer, or even as having been once perused by him after they were written.

The former can only take place in unsexual flowers, consult Aldrovanda, and Dutrochet, *Recherches. Mem du Muse tom. viii. and* Brown,—*Ann. des Sciences, tom. viii. p.* 211.

Brongniart agrees entirely with Brown, so far as Mr. Brown goes.

Mr. Lindley has adopted the views of M. Mirbel, but if mine be correct, the 4 last aphonisms in his excellent little Key to Structural and Physiological Botany, will require some alteration.]

The book of M. Brongniart, is worthy of the distinction bestowed on it by the illustrious Academy. And had the author divested himself of the theory therein adopted, and which was perhaps pre-conceived, it would have ranked among the very first productions. From its appearance we may date the possession of a correct knowledge of the structure of the style, and stigma; the communication by a particular tissue between this body and the placenta, and in many cases with the ovula; and that fecundation is not effected through the medium of any portion of the vascular tissue of the style.

The determination of the absolute cellularity of the *filets conducteurs*, and their total distinction from the nourishing vessels.

See his Memoire p. 58 for some excellent observations.

It is but justice however to M. St. Hilaire, who is said by B. to be of opinion, that the *filets conducteurs* are vascular, to remember that this excellent Botanist distinctly states, that these *filets* are occasionally cellular as in Cuphea. It would still however appear, that M. St. Hilaire thinks this is only an exception to a general rule; *See Archives, vol. ii. p.* 390.

To M. Brongniart we owe the general establishment of the fact of the emission of *boyaux*, their being derived from the inner membrane of the pollen, and of their passage into and beyond the stigma. But he seems to have lost sight of their ultimate destination as represented by Amici, and hence his theory.

According to Mr. Brown, Amici's discoveries seem to have been complete from the first, so far as regards the application of the tubes to the ovula. *See on the sexual organs, p. 5.*

From the remarks of Mr. Brown, on Cephalotus, *Flind. Voy.* 11. *p.* 601, I should imagine, that the ovule has only one coat, the pendulous enclosed sac being nucleus. The remark is certainly brief, nor is there any reason assigned why he states he has no doubt that the radicle points downwards. No allusion is made to an opening in the coats of the ovule. Neither is there any explanation in his remarks on Compositæ; *Linn. Soc. Trans. xii.* 136, where the subject is reserved for a future separate essay.

With respect to the site of the raphe, I believe that in Henslovia this cord is as often remote from, as next to the placenta. There is no resupination.

[Do the powers which exist so eminently in Cycas and Gnetum of contracting, depend on fecundation?]

Mr. Brown announces the nudity of the ovula of Gnetum, etc. in these words—

"It would entirely remove the doubt that may exist respecting the points of impregnation if cases could be produced where the ovarium was either altogether wanting, or so imperfectly formed, that the ovulum itself became directly exposed to the action of the pollen or its fovilla: its apex, as well as the orifice of its immediate covering, being modified and developed to adapt them to this economy.

"But such, I believe, is the real explanation of the structure of Cycadeæ, of Coniferæ of Ephedra, and even of Gnetum, of which *Thoa* of Aublet is a species."

The accompanying drawings will prove the accuracy of his statement, and the resemblance in every essential point between the inner body, and the nucleus of the ovulum in ordinary structures.

I have not observed any appearance of secreting surface at the apex, which is in all generally unequal. Neither have I seen its occasional projection beyond the orifice of the outer coat. Its cohesion with that coat has escaped me. The statement of the ovula of Cycadeæ consisting of a nucleus and one coat only, is an oversight. Cycas *merguiensis* has two, cohering intimately; Agathis is also an instance of the correctness of this view.

This celebrated Botanist can only have examined certain stages of the ovula of Gnetum, to which he attributes three envelopes, considering as two the coats of the nucleus, but not referring the third, or outer to any thing. I hope I understand rightly: to prevent mistake, I quote his words—

"In Ephedra, indeed, where the nucleus is provided with two envelopes, the outer may perhaps be supposed rather analogous to the calyx, or involucrum of the male flower, than as belonging to the ovulum, but in Gnetum, where the envelopes exist, two of these may, with great probability, be regarded as coats of the nucleus."

Mr. Lindley considers the outer, concerning which Mr. Brown is silent, to be analogous to a carpellum.

Historical Notes.

For the history of the ovulum, refer to Mr. Brown's celebrated Memoir on Kingia; to which the first accurate knowledge of this important organ is to be attributed.

Flinder's Voy. 11. *p.* 681, *and Linn. Soc. Trans. xii. p.* 136, Mr. Brown refers to some other of his publications with reference to the state of his knowledge at that time, but which he informs us had been overlooked by all Botanists.

With regard to the various and mistaken opinions referred to in the historical account I may observe, that they all arose from an error but too frequent up to a very recent period, viz. a disposition to convert a science of observation into one of speculation. As a proof of this, we find that the

account of that eminent observer Grew, given in 1672, erroneous as it is, yet is in some points nearer the truth than that perhaps of any other, up to the appearnce of Treviranus' Memoir on the development of the Vegetable Embryo in 1815.

And as an additional proof, I may be allowed to contrast the opinions of M. Mirbel in 1815, with those of the same distinguished Botanist in 1830 ?*

The most important points established in Mr. Brown's memoir are—

1. The *universal* existence of the foramen.
2. The frequent inversion of the inner membrane with regard to the testa.
3. The impossibility of the radicle of the embryo pointing directly to the hilum.
4. That the radicle is never absolutely enclosed in the albumen.

On this subject Mr. Brown says, 'another observation may be made, less obviously a consequence of the structure described, but equally at variance with many of the published accounts and figures of seeds, namely, that the radicle is never absolutely enclosed in the albumen ; but, in the recent state, is either immediately in contact with the inner membrane of the seed, or this contact is established by means of a process generally very short, but sometimes of great length, and which indeed in all cases may be regarded as an elongation of its own substance.' From this rule I have found one apparent deviation, but in a case altogether so peculiar, that it can hardly be considered as setting it aside.

5. That the raphe, or vascular cord of the outer coat, almost universally belongs to that side of the ovulum which is next the placenta.

The exceptions mentioned in Euonymus, and the perfect ovula of Abelia, are due to resupination.

6. The late development of the arillus, and its non-interference with impregnation.

* Elements de Physiologe veget. et de Botanique. tom. i, pp. 49 and 314.

7. Determination of the number of coats, the distinction of testa by raphe, and of nucleary or third coat by imperforate and often sphacelated apex.
8. The explanation of the true structure of true Nymphæaceæ, Piperaceæ, and Saurureæ, etc.

The only point on which I would presume to differ, relates to the Amnios, which Mr. Brown mentions as existing in a few plants, although in the next paragraph it would appear, that he considered its existence at an early stage to be universal, and that its non-existence is due to obliteration.

[Apparent inversion of embryo in Lemna.

Anomalies of testa.]

I have still to notice the modus operandi of the formation of the embryo. Before doing this, (which will merely consist in a recapitulation of doctrines, all of a somewhat fanciful description,) it may not be amiss to sketch the usual mode of fecundation.

The first steps of this all-important phenomenon, consist in the application of the pollen to the surface of the stigma, or when this organ does not exist, as in Cycadeæ, Coniferæ, and Gnetacea, to the ovula themselves.

The result of this application is the *invariable* emission of the pollen boyaux, which passing through the lax tissue of the stigma, enter the stigmatic canal, by which they are guided to the placenta, and hence to the ovula; into the foramen of which they invariably enter. Their subsequent functions are as yet unknown; but from certain instances, it is lawful to conclude that they penetrate into the substance of the nucleus, to a greater or less depth.

The consequence of this application, is in some cases the appearance of the embryonary sac, and then of the embryo; and in others in which the sac exists before fecundation, the appearance of the embryo alone.

The actual origin of this body is, as might be expected, involved in absolute obscurity.

It is to M. Amici as above observed that we are indebted for the discovery of the emission of the boyaux, and for the important fact of their reaching to the ovulum. The possible existence of the boyaux was however known long previously, for I remember seeing obvious representations of such among some sketches of pollen by Mr. Bauer, made, I believe, about 1798.

The announcement of M. Amici with regard to the boyaux, was more fully worked out by M. Brongniart, who ascertained their existence generally, and supposed that they did not reach the cavity of the ovarium.

Thus, arrested as it were, on the threshold of one of those discoveries, which have given additional claims to the title of the first botanist of this or any other age, M. Brongniart formed an hypothesis, on which rests the erroneous portions of his otherwise admirably written book.

M. Brongniart having failed in detecting the direct communication of the tubes with the ovula, supposes that in all cases the fecundating matter which he takes to be the granules contained in the boyaux, reaches the ovula through the inter cellular passages of that lax tissue continuous with the stigma, existing in the style, and which he has shewn in many cases to be continued even to the ovula, the foramena of which at the period of fecundation are presented to it.

But the same hypothesis has led this distinguished author to certain other conclusions, which will be perhaps found not to present much unusual anomaly. I allude particularly to his account of such stigmata as are covered with an epidermis, and especially to his figures of Nuphar. For it is at once obvious, that in this instance in which the boyaux are said to become *Soudè* with the epidermis, that insuperable objections exist to the passage of the granules even into the stigmatic tissue, since two membranes are interposed, viz. that of the tube, and that of the stigma. This difficulty is

removed partly by the supposition of openings, existing in the tubes!

The same hypothesis has led to the statement that at least 8 days are sufficient to allow of the completion of the passage in Cucurbita, to this I have elsewhere alluded, and to the supposition that months are required in Corylus for the completion of the same passage. Mr. Brongniart considers in this case, that the impregnating fluid either remains stationary in some part of the plant, or that more probably the embryo after its first development remains in a torpid state. I have elsewhere mentioned that a discrepancy exists between Mirbel and Brongniart as to the degree of development of the ovula of Corylus. I may observe that even if Br's. statement be correct*

his more probable idea is contrary to all analogy, otherwise, there may legitimately be inferred to exist, no confined limits to the growth of a body endowed with a special vitality, as the pollen boyau no doubt is.

The completion of the discovery is due to Mr. Brown, to whose paper I refer. The fact is now admitted on all sides within the scope of my experience.

Within the scope of my experience, limited as it necessarily must be, there is no modification which destroys the possibility of the direct communication of the tubes with the ovula. But it must be remembered that Mr. Brown, the first authority in this, as in all other points connected with vegetables, remarks that it does not follow that descent and insertion of the tubes should be expected to extend to all Phænogamous plants; for among these some structures of the female organ exists, which hardly admits of this economy. See Suppl. Obs. on sexual organs and impregnation in Orchid. and Asclepiad. p. 4.

* The consecutive order of the MS. not having been marked by the author, breaks, corresponding with the MS. pages, are left in the type.

Mr. Lindley while allowing that there is nothing positive to oppose to the precise and most complete statements of Mr. Brown, except the indirect observations of Mr. Bauer, still thinks that the mode of fertilization in Orchideæ is far from being determined. For the arguments against, see Mr. Brown's remarks.

The few arguments he brings forward are, I think, untenable. For with reference to the possibility of there being two modes of fertilization, it is more consonant to sound philosophy to believe that nature always follows one settled plan; that exceptions to general rules almost always confirm, rather than weaken them. And with regard to the difficulty of bringing the two organs into contact which Mr. Lindley thus expresses, " by so placing the anther that it is next to impossible for the pollen to touch the stigma until the energy of the former is expended,"* it will I think be allowed, that the energy of the pollen is as persistent as that of any other parts of plants, except the seed, and perhaps much more so.

The family in which above all others the tubes have been traced into the ovule, is Asclepiadeæ. And on this order both Mr. Brown and M. Brongniart appear to have been simultaneously employed: but neither at the same period succeeded in tracing them into the ovula, although Mr. Brown had traced them to the placenta, See Introduct. p. 284.

But I do not agree with Mr. Lindley when he incorporates the statements of these two authorities, and for this reason, that they differ in two or three points of primary importance,—1st. Mr. Brown states, that in all cases in which fecundation has taken place, the mass has changed its position, being placed in the fissure between two anthers, while M. Brongniart states, that there has been no change of position, the mass consequently remaining in the cell of the anther.

* Introduct. Second, Ed. p. 285.

My own observations made on 3 or 4 genera both with pendulous and erect masses, lead me to agree entirely with the statement of Mr. Brown, and although I have seen protrusion without change of position, in no instance has such been attended with the performance of fecundation.

Mr. Brown, however, states, that protrusion was often found to take place in Asclep. phytolaccoides without any change of position. "The tubes produced in this situation often acquire a great length, but coming immediately on their protrusion from the mass in contact with the membrane of the anther , their course is necessarily altered ; and in their new direction which is generally upwards, they not unfrequently arrive at the top of the cell, or even extend beyond it." p. 32.

It is thus barely possible that in some cases they may find their way between the anthers, and so reach the point, on which they can penetrate into the style.

The next point, regards the existence of a tissue analogous to that usually forming a stigmatic surface, at the point of entrance of the tubes. Mr. Brown, whose observations were made on 7 species of Asclepias, and on Cynanchum, (Vincetoxicum nigrum) distinctly states that in no instance could he "observe the slightest appearance of secretion, or any difference whatever in texture, between that part and the general surface of the stigma."

My observations lead me to infer, that in one genus such difference does exist, in another it certainly does not.

M. Brongniart's observations, were made on Asclepias syriaca, A. amæna, and A. fruticosa, as he distinctly describes the base of the stigma close to the summit of the style, as being really stigmatic, and as being continued into the interior of the style. Memoire p. 21.

Connected with this is his obvious misunderstanding of the relations of the anthers one to another, as well as to the stigma ; at least such is the construction I put upon this passage, "si on examine à la même époque le stigmate et ses relations avec les anthères, on voit que cet organe très-volumeneux et commun aux deux styles, d' une forme á peu près

prismatique à 5 angles, est eppuyé par tout le pourtour de sa base sur le bord interne et supérieur du tube formé par les étamines réunies. Il n'y a pas, il est vrai, continuité de tissu entre ces parties, mais application et adherence assez forte, de manière à ne laisser ancune communication entre les anthères et la base du stigmate qui correspond à cette cavitè formée par les filets des ètamines soudés en tube et par le tube de la corolle et qui occupe les ovaires et les styles." p. 20.

So that this author would appear to have overlooked the fissures that exist between each anther, and which communicate directly with the stigma.

On the actual nature of the functions performed by the granules, Mr. Brown abstains from making conjectures. This observation led him, however, to conclude that they are agents of nutrition to the tube, rather than of absolute impregnation and supply, " the really active particles in this function being probably much more minute." x, p. 35.

M. Brongniart supposes throughout that these granules are the organs of fecundation, as might be supposed from his calling them spermatic granules, and believes them to be the essential organs of fecundation, thus asking whether the central cell he states to be visible in some nascent embryo, be not the spermatic granules ?

Subsequently he looks upon the embryo as formed by one or more spermatic, and by several ovulary granules.

The granules he considers as in most instances, of one form in each species; and in addition he says, that the exceptions may arise from the mixture of other larger granules of irregular form, and which he is disposed to regard as concrete drops of resin or of oil. Moreover he considers it probable that these extraneous bodies perform the same duties as does the mucus in the semen of animals. p. 5.

*

It may not be amiss here to state the possible number of coats existing in the ripe seed.

The possible number is four—

1. The coat which almost always forms the testa of the seed.
2. The inner integument or tegmen resulting from the second coat.
3. The nucleary membrane resulting from the attenuation of the nucleus, dependent on the enlargement of the embryonary sac. [Nucleus perforate in Cycas.]
4. And the sac of the embryo itself.

A greater number of coats may apparently exist as I have elsewhere hinted, but this is owing to the development of the various layers forming the testa.

The only instance of the actual existence of 5 coats is in Gnetum, the supernumerary coat of which results from the permanence of the sudden formation of a coat, produced upwards in the form of a style terminated by a stigma, and which is obviously intimately connected with a style in functions; i. e. with the completion of fecundation.*

The supposed cases of existence of an additional coat in the vitellus of certain seeds are spurious, this organ being nothing more than the embryonary sac prevented from assuming its ordinary form, by the condensation, as it were, of the nucleus, owing to the deposition of albumen.

In Tulipa Gesneriana the embryonary sac is quartine, and I believe that the secundine is really the nucleus, at least in the figures representing the more advanced stages.

In Quercus robur the quartine would appear to be the embryonary sac.

In Lunaria annua the quartine is the embryonary sac.

In Pisum sativum ditto ditto.

* See *Gnetum*, p. 167, which belongs to this place.—Ed.

In Cicer arietinum ditto ditto, (quintine developed inside and before the quartine.)

Lupinus varius ditto ditto.

Phaseolus coccineus ditto ditto.

Anagallis arvensis ditto ditto.

In Cucumis Anguina, the embryonary sac is quintine, quartine none.

In Euphorbia Lathyris the sac is the quintine, quartine none, and I opine, that the nucleus is represented as the secundine; in this case the more opaque inner layer of the primine will be the secundine. This will agree well with Brongniart's observation.

In Statice the quintine is probably a development extraordinary of the *filet suspenseur*, perhaps it is the embryonary sac, in which case M. Brongniart's quartine will be nucleus; this would be conformable.

In Myrica Pennsylvanica, the embryonary sac is quintine, the nucleary membrane is either nucleus or quartine! Mirbel is not certain which.

In Tradescantia virginica, the embryonary sac is quartine.

In Polygonum tataricum, M. Mirbel's explanation is at first right, but subsequently, reasoning on the assumed possibility of the nucleus even at this early period disappearing entirely, he almost makes the nucleus the secundine. Again in another figure, his quartine is nucleary membrane, or tercine, and his quintine, quartine or embryonary sac.

M. Mirbel is of opinion, that his quintine is the sac of the amnios of Mr. Brown, and that this gentleman has erred in stating that it is of uncommon occurrence.

Mr. Brown says—" the membrane of the nucleus usually constitutes the innermost coat of the seed. But in a few plants an additional coat, apparently originating in the inner membrane of Grew, the *vesicula-colliquamenta*, or amnios of Malphighi also exists." But this passage will not bear the construction when viewed in conjunction with the subse-

quent paragraph which I have quoted before. The real construction is obviously this—that the amnios exists in all plants in its earlier stages, in a few only in its more mature stages.

Outer integument, Testa, Primine of Mirbel.

This coat, the outermost in the unimpregnated ovulum, continues the most external covering of the organ as it advances to maturity, except in some instances of unusual development of the arillus. Great changes however may occur in it, so that its original state shall, in the ripe seed, be totally obscured. This was pointed out by M. Mirbel.

The presence of vessels will, in all doubtful cases, decide whether the tegument is testa or tegmen. For this we are indebted to Mr. Brown, whose remarks I cannot refrain from quoting —" The testa, or outer coat of the seed, is very generally formed by the outer membrane of the ovulum; and in most cases where the nucleus is inverted, which is the more usual structure, its origin may be satisfactorily determined; either by the hilum being more or less lateral, or more obviously and with greater certainty, where the raphe is visible, this vascular cord uniformly belonging to the outer membrane of the ovulum.

"The chalaza, as properly so called, though merely the termination of the raphe, affords a less certain character, for in many plants it is hardly visible on the inner surface of the testa, but is intimately united with the areola of insertion of the inner membrane or of the nucleus, to one or other of which it then seems entirely to belong. In those cases where the testa agrees in direction with the nucleus, I am not acquainted with any character by which it can be absolutely distinguished from the inner membrane in the ripe seed; but as few plants are already known, in which the outer membrane is originally incomplete, its entire absence, even before fecundation, is conceivable: and some

possible cases of such a structure will be mentioned hereafter."

In many instances, however, in which the vascular system is totally wanting, no proof can be given of the true nature of the tegument. Because such want of vascularity is by no means confined to any modification of an ovulum, of this there are obvious instances.

And again, with regard to those cases in which singleness of covering results from adhesion, it is in many cases difficult and perhaps impossible to distinguish the limits of the coats, while in others, although the union be firm, lines indicating the original distinction are visible enough.

In all such cases recourse must be had to examination at a sufficiently early period, on this Mirbel very justly lays great stress, and he has given it as his opinion, that in almost all cases, and perhaps in all, two teguments really exist at some period or another.

Arillus.

This production remains to be explained. This name has been applied to every substance surrounding the seed of an unusual nature.

Thus the testa of Cucurbitaceæ is nothing else but the separation of that part of the fruit lining each cavity in which the seed is lodged. In other plants, as in Ternstrœmiaceæ, etc. it is a growth of the testa.

The true Arillus is a mere growth of the funicle, as Mr. Brown has remarked; it is never complete, and its development takes place chiefly after fecundation. "It is, however, worthy of remark, that in the early stage of the ovulum, this envelope is in general hardly visible even in those cases, where, as in Hibbertia volubilis, it attains the greatest size in the ripe seed; nor does it in any case, with which I am acquainted, cover the foramen of the testa until after fecundation," it varies much in form, but in general has more or less of a cup shape; in others as in Pharnaceum, it is filiform.

It is at once distinguished from the teguments by its never forming a perfectly closed sac.

Mr. Lindley has supposed that in Scepaceæ it is accessory to fecundation, and that it subsequently becomes the fleshy part of the seed. I must however say, that this view which is erroneous, is founded on the description of the plant by Roxburgh.

M. Mirbel however, describes the arillus of Nymphæa alba, as becoming subsequently a perfectly closed sac, although from his drawing it would appear obviously to be an extension of the placenta. *See his work Pl.* 6.—*Fig.* 15, *p*. 60.

Arillus often eatable.

Inner tegument, Tegmen, Secundine.

I have just alluded to the opinion of Mirbel as to the almost universal existence of this covering, that in the instances cited by authors to the contrary it had become united to the primine.

This author is of opinion that it never exists as a covering to the seed, but that it sooner or later becomes intimately united with the outer membrane, to such a degree that its existence is not demonstrable.

For my own part, observations have led me to suppose that this tegument is in some cases *ab origine* single. Hence the difficulty of ascertaining whether it is testa or tegmen becomes materially increased ; because the tegmen being first formed, it would seem to follow, that in all cases in which such singleness can be demonstrated, the coat must be tegmen. Hence too this coat may be vascular, contrary to the usual opinion.

On the subject of this coat Mr. Brown admirably remarks, " the inner membrane of the ovulum, however in general appears to be of greater importance, as connected with fecundation, than as affording protection to the nucleus at a more advanced period. For in many cases, before impreg-

nation, its perforated apex projects beyond the aperture of the testa, and in some plants puts on the appearance of an obtuse, or even dilated stigma; while in the ripe seed it is often either entirely obliterated, or exists only as a thin film, which might readily be mistaken for the epidermis of a third membrane then frequently observable."

With regard to obliteration it is, I think, much to be doubted whether it can take place to such a degree as to annihilate the existence of pure vegetable membrane or of cellular membrane. For my own part I believe that a sufficiently careful examination will, in all cases, in which it does not adhere to the outer coat, detect its presence.

M. Brongniart says, that in all cases in which the nucleus is not absolutely naked, that there must necessarily be a membrane within the testa, derived from the nucleus, that as this always exists in the ovule, it ought always to exist in the seed, and that when it cannot be detected it is owing either to its excessive tenuity, or to its cohesion with the testa. We may infer hence, that M. Brongniart holds a similar opinion regarding all the other coats, that may exist in the ovulum.

It would seem that Mr. Brown admits the possibility of obliteration, for in treating of the amnios, he says, " in such cases, however, its proper membrane is commonly obliterated, and its place is supplied either by that of the nucleus, by the inner membrane of the ovulum, or, where both these are evanescent, by the testa itself."

Generally speaking, the inner coat does not project beyond the outer foramen at the time of fecundation, occasionally however, it does, and even to a great length. M. Mirbel only knew of one instance of such protrusion in Statice.

I must however observe, that this would according to Brongniart be testa. *See Memoire sur la Generation, p. 37, note.*

I may further state, that according to Mirbel, Brongniart has in his illustrations of Ricinus communis confounded the primine with the secundine coat, and that his nucleus is nothing more than the secundine. To me, however, nothing can be clearer than the illustrations of Brongniart.

*

This is certain, that in figure 4, which presents a section there is no trace of a nucleus. Indeed in the explanation Mirbel says, that it has disappeared, that it is doubtless intimately united with the secundine, a circumstance, he adds, of almost universal occurrence.

Foramen, Endostome, Exostome, Micropyle.

By the term foramen, I mean the opening of both teguments when two exist, this becomes mycropyle in the seed; an useless discrimination. M. Mirbel adopts the term exostome for the opening of the outer integument, and endostome for that of the inner. But the distinction is needless, and the term endostome can scarcely be said to be applicable in those cases in which at the epoch of fecundation, it is exserted beyond the endostome.

The existence of the foramen has not escaped its share of denial. Mr. Raspail's opinion that the teguments *of the seed* are imperforate, is worthy of one who places more reliance on his own observations made with an ordinary lens, than on those of such men as Brown, Brongniart, and Mirbel, aided by the best instruments.

The foramen, after fecundation, becomes more or less closed up; it may however, even in the ripe seed, be very generally traced.

In some few instances, as in Bucklandia, it preserves its original appearance.

Generally it is indistinct, in some cases however, by a fungous growth of its lips it becomes carunculiform.

It is generally more or less prominent, generally very much so in the ovulum; it may however, owing to inequality of development as Mirbel has shewn in Tradescantia, even in the ovulum become depressed as it were, below the level of the other parts. *Memoire p. 27, Pl. 6.—Figs.* 6, 7, 8, 9.

Mr. Brown states that in Lemna he has found "an apparent inversion of the embryo with relation to the apex of the nucleus." M. Brongniart however has described and figured the embryo of Lemna as presenting no anomaly on this particular point.

It is scarcely necessary to repeat, that the determination of its situation is of primary importance, for it indicates the site of the future radicle.

This, one of the most valuable practical rules in Botany, we owe to Mr. Smith, and Mr. Brown.

Exceptions however occur to it in Ricinus and other instances, in the ripe seed.

Further observations are therefore necessary.

See Archives Pl. 12, p. 99. The drawings however do not satisfy me as to the body in which the embryo is developed. Neither is there any explanation concerning the raphe, which would appear to be vascular.

The Nucleus, Amande, Nucella, Tercine, and Quartine.

[This organ, is of a much more important nature than either of the preceding, it is therefore much more universal. I am of opinion however, that in certain Visca it is totally wanting, and strange as the above assertion may appear, I consider myself justified in adopting it from the consideration of Santalum.

The nucleus is in almost every instance a cellular fleshy mass, occupying the centre of the ovulum, with the integuments of which it always agrees in direction.

It has, if I may use the expression, a suigeneris appearance, so that to a practised eye it is at once recognised even when absolutely naked.

To the possibility of its being deprived of any tegument, Mr. Brown has alluded.]

By its excavation, this organ, gives rise to an additional coat, which may perhaps always be detached in the seed, except in those cases in which it adheres in the ovulum firmly to the tegument—on it Mr. Brown remarks—" This third coat is formed by the proper membrane or cuticle of the nucleus, from whose substance in the unimpregnated ovulum it is never, I believe, separable, and at that period is

very rarely visible. In the ripe seed it is distinguishable from the inner membrane only by its apex, which is never perforated, is generally acute, and more deeply coloured, or even sphacelated."

M. Brongniart specified Thesium as an instance, and suspects that a similar formation will be found in all Santalaceæ. I am able to corroborate this so far as Santalum itself is concerned, and my friend M. Decaisne informs me, that such is his view of the ovula of Helwingia. M. Mirbel is however, I believe, opposed to the idea, at least to that of M. Brongniart.

I believe it will be found that the statement is correct, and I may observe that the difference between a really naked nucleus, and one which is united intimately to its coat, is very distinct, although not easily to be expressed in words.

The nucleus undergoes no important special change until at or about the period of fecundation.

The first indication consists in an appearance of opacity visible generally towards its centre, and which appears to be the prelude to the formation of excavation.

The formation of the cavity, which is antecedent to the appearance of the embryonary sac, generally, I think, commences from below upwards. It is carried on to a greater or less extent, but in all cases, excepting Santalum and those in which albumen is deposited in the nucleary tissue, this organ becomes at length reduced to a thin coat. And in this form it will in most cases be distinguished in the ripe seed.

For the membrane resulting from the excavation of the nucleus, M. Brongniart proposes the name of *membrane perispermique.*

In his view of the nucleus, M. Brongniart agrees with Mr. Brown, except in the mamelon d' impregnation. Sometimes however, M. Brongniart, if I understand him rightly, appears to be of opinion, that in all cases the apex of the nucleus is exposed at the time of fecundation, even in those (as Compositæ), in which it coheres with the coat.

Subsequently, however, he expresses himself clearly to this effect: " nous avous vû que l' amande se presente sous la forme

d'une masse parenchymateuse fixeé par une de ses extrémités à la chalaze, libre ordinairement dans le reste de sa surface, et se terminant par un mamelon plus ou moins prolongé, qui correspond à la perforation des tégumens de l' ovule, qui souvent s'engage dans ce trou et qui même peut faire saillie au dehors." p. 81.

The most important points of M. Brongniart's ideas respecting the nucleus, and which he says have quite escaped Mr. Brown, have not been corroborated by M. Mirbel, nor do my own observations, at all coincide with his.

He says that the embryonary sac exists before fecundation, and that even at this period its communication with the chalaza may have been effected, and to such a degree may this evolution take place, that even at the period above alluded to, the nucleus may be reduced to be a thin membrane. M. Brongniart describes a communication, which from his hypothesis regarding fecundation, would be necessary, between the embryonary sac and the apex of the nucleus, and to render this required communication still more efficient, this tube is represented as projecting in many cases beyond the apex of the nucleus (p. 98); and subsequently, he thinks, that this exsertion takes place in all plants at the time of fecundation.

The instance cited by this distinguished author, in which this tube is most conspicuous, is in certain Cucurbitaceæ, and in this he would appear to be confirmed by M. Mirbel, see his figure of C. anguria. Of the existence of a tube projecting beyond the apex of the nucleus, I am aware of several instances, particularly in Cucurbitaceæ, and Asclepiadeæ but I have never been able to ascertain its communication with the embryonary sac, except in Santalum, in which it is a prolongation of the sac in question.

The description of the tube given by Brongniart accords well with what is now known of boyaux, with the exception that Brongniart figures it as closed at its exserted end, and

it accords well with what he says of its never being visible before the period of fecundation.

I have no doubt but that subsequent examination will prove it to be of the nature alluded to.

But I doubt much whether such very distinct communications will be seen as are represented in his excellent figures, in which the openings in the tubes, are obviously made to conform to his peculiar theory.

Even if it were proved that such tubes are not the remains of the boyaux, analogy would lead us to conclude that they are extensions of the embryonary sac, such extension being a more direct method of accounting for them than that under examination.

To this, however, there is an objection which I consider fatal, viz. that as the embryo is always developed at the apex of the embryonary sac, in all such cases it would necessarily be developed externally to the ovulum, of this an instance actually occurs in Santalum.

I am aware that Mirbel considers the embryo of some Leguminosæ, as for instance Pisum sativum, to be formed at a considerable distance from the apex of the embryonary sac; but doubts must always be attached to the observed site of such a minute body, when sections are resorted to. And in the figure 19, pl. 9, I would beg to remark that the radicle of the young ovulum points to the geometric, not the real apex of the seed, a site totally contrary to all analogy.

Arguing on the supposed existence of communication, M. Brongniart considers that a period of 8 days at least would be sufficient to ensure impregnation. If my idea however be correct, fecundation had been already completed. I shall return to this subject however, when speaking of the performance of this function.

M. Mirbel's account of the nucleus and, I may add, of all the remaining formations is materially different. This distinguished botanist states, that in certain orders, as most Leguminosæ, and above all in Labiatæ, Boragineæ, the ovulum must be examined at a very early period to enable one to ascertain the existence of the nucleus, owing to

its becoming hollowed out and dilated into a sac very shortly after its first appearance. It soon becomes intimately united to the secundine, its cavity remaining empty for sometime.

He says elsewhere that its duration is various, being often ephemeral, in others again becoming the tercine. This tercine either entirely disappears or becomes applied to and even united with the secundine.

In others again, the nucleus remains as a cellular mass, which is either pushed back by other growth or by the pressure of the inner parts, or as in some becomes converted into perisperm. That in the instances of its destruction, of its conversion into tercine, of its union with the secundine, it generally happens that the ovulum presents interiorly a large inner cavity, filled with the water of vegetation.

He states, however, that in other instances it is of longer duration either in its rudimentary form or in that of tercine. It is not in my power to corroborate these observations ; all that I have seen leads me to suppose, that the changes that take place in the nucleus occur at or about the period of fecundation. And I am not acquainted with any instance in which the nucleus becomes united with the secundine, until perhaps long after fecundation.

Quintine. Sac of the Amnios ; Embryo according to M. Mirbel.

With M. Mirbel's quintine I am unacquainted. In his first paper he says that it is not uncommon, and that its development is only complete when it takes place in a nucleus which has remained filled with cellular tissue, or in a quartine of similar structure. He compares it to a fine thread, *boyau delié*, fixed by one end to the summit of the nucleus, and by the other to the chalaza.

In his subsequent memoir, he says he has only been able to ascertain its existence in certain species, and he mentions about six instances.

He describes it as he did in his former paper, and adds that it is only when the embryo commences that the quintine swells into a cellular mass, either transparent and membranous or opaque and fleshy, this swelling almost always takes place from above downwards.

He says that when the chalazal appendix exists the quintine is attached to its apex, that the development of both is simultaneous.

It would appear likewise that in some cases the embryo is developed outside the quintine, as in Statice, for we are told p. 55, that the albumen is developed in the quartine, such a structure is so contrary to all analogy, that I have little hesitation in saying that if this quintine be not quartine, it is a mere modification of the stalk of the embryo.

In the instance of Cicer arietinum figured to shew the quintine, there is enough to raise a suspicion that it is the embryonary sac in an early stage, at least it agrees with this sac in situation and appearance.

Embryonary sac, Amnios, Quartine.

This name which is very appropriate, originated with M. Brongniart, who rightly supposed that the embryo was formed in it in *almost all* cases. M. Brongniart, however, confines its application to the ovulum; subsequently however, if I understand him rightly, he supposes that the embryo in most other plants (he is speaking of Ceratophyllum) is not actually contained within the sac, but that the sac and the embryo have the same relations that our viscera are supposed to have to our peritonea?

This sac, to which the name embryonary is most aplicable, since in it the embryo is invariably developed, commences as I have stated in the shape of a vesicle. It is situated generally at that part of the nucleary excavation which corresponds to the apex of this organ, but in some it is developed from the opposite point. It is the only essential part of an ovulum antecedent to the apperance of the embryo. This assertion I consider justified by the consideration of Santalum and of Viscum.

When completely developed it communicates both with the apex, and base of the nucleary cavity: its diameter being either uniform throughout, or larger towards the apex of the nucleus, dwindling inferiorly into a mere thread of communication. Of this sac there are two curious modifications, and although the origin is in both cases the same, yet the growth is materially different, in the one consisting of the simple extension of the original simple vesicle, in the other consisting in the growth of additional cellules from the surface of the original simple one.

I find the presence of albumen almost always allied to the existence of the first form.

[Cucurbitaceæ a strong exception. The macropodous forms however, are not an exception, because, in almost all of them, the embryonary sac contains albumen, and in these it is membranous; it will be interesting to ascertain whether in these, similar modifications of this sac are observable.]

In the other modification, the sac even at a very early period presents obvious traces of cellularity of composition.

I believe that this sac is always distinguishable in the ripe seed. Although it frequently becomes intimately incorporated with the albumen, the examination of the surface of this, will generally be found to reveal its existence.

In many instances where no albumen is formed, or in other words, when this sac is membrano-cellular, its existence in the ripe seed is most conspicuous, particularly in those in which the nucleus adhered in the ovulum to the coat. I need only instance Compositæ, and Boragineæ; in the former of which, this coat has been described as albumen.* Asclepiadeæ and Apocyneæ, are other instances.

The distinction of the coat resulting from this sac in the ripe seed, from that resulting from the nucleus is difficult to draw, but its apex, although frequently similar in form to that of the nucleus, is never discoloured.

* I may here observe, that the seeds of Compositæ are not, at least in a number of cases akenia, but rather caryopsides, the testa being in most cases I have been able to examine, united more or less firmly to the cavity of the pericarpium.

If it be found never to be obliterated, its situation will at once point it out, and I think it might be affirmed, that in all cases the coat in contact with, or next to the embryo, is derived from this sac.

On this membrane Mr. Brown observes "in general the amnios, after fecundation, gradually enlarges, till at length it displaces or absorbs the whole substance of the nucleus, containing in the ripe seed, both the embryo and albumen, where the latter continues to exist." Nothing can be more clear or more true than this.

Brongniart describes the embryonary sac as disappearing in all exalbuminous plants, either completely or by uniting with the parenchyma of the nucleus, and forming the inner membrane; and he figures *(See Memoir Pl. 42, fig. 1,)* the immediate envelope of the seed as being derived from the nucleus.

M. Brongniart's opinion corroborates the truth of Mr. Brown's statement.

At page 92, however, this author refers to the difficulty of examining the embryonary sac before impregnation, on account of its smallness. There is some difficulty in reconciling this to his statements elsewhere.

I have already alluded to the additional organ described by Brongniart as forming a communication between the apex of the embryonary sac, and that of the nucleus. And if, as I believe it will be found to be the sac under consideration, (and which is frequently, nay perhaps generally, formed after fecundation,) it is obvious that this idea is untenable.

M. Mirbel's quartine is obviously the amnios of Mr. Brown, and the embryonary sac of M. Brongniart.

As in Cicer arietinum, and Phaseolus coccineus, and Lupinus varius.

It would not be difficult to shew that Mirbel has more than once confounded his quartine with his quintine, and vice versa. (See his Figures etc. of Tradescantia.) And even occasionally with the nucleus, as in Myrica pensylvanica, and Quercus Robur. In Polygonum tataricum his quintine is

really quartine, i. e. the embryonary sac. The figure given is probably incorrect, as I have never seen such an instance of absolute union.

Mirbel describes its growth as in general simultaneous, and commencing from every point of the sides of the ovulum; in some instances, as in some Leguminous plants, it commences from the apex of the cavity, and grows downwards. The earlier periods of its growth have escaped this well known and eminent physiologist.

My own observations lead me to conclude, that from whatever point it is developed, it first lines the cavity of the nucleus, subsequently becoming filled with more or less cellular tissue. And in albuminary forms the primary formation of cells commences at the end at which the embryo is situated. It is even confined to this end for sometime, so that we may have an embryonary sac fleshy at one end, and membranous at the other.

M. Mirbel says of the quartine, that it has escaped notice owing to its having been confounded with the tercine, and that he has only seen it in those ovula, the tercines of which, become united in a very early stage to the secundine. *Memoire* 1, *p.* 9.

Embryo.

This organ first appears in the form of a cellular vesicle, attached by a slight cellular pedicel to the apex of the embryonary sac. Its development consists in the appearance of other additional cellules in its interior, which cellules always contain much active molecular matter. It continues for sometime globular.

In Dicotyledones, the notch indicating the division of the cotyledons soon appears, and at or about the same moment the radicular end assumes a somewhat conical form.

The subsequent changes are too well known to require recapitulation, indeed they consist merely of an increase of growth.

The plumula is the last part formed.

The radicle always corresponds to the apex of the embryonary sac, and in almost all cases to the apex of the nucleus.

The green colour of the embryonary sac in its early stages did not escape M. Brongniart.

The communication between the embryo and the embryonary sac is always cellular ; never indicating the slightest appearance of vascularity. And yet many embryos are vascular.

The duration of the funicle or cord of communication is various, generally no trace can be discovered of it at the period of maturity of the embryo.

In others again as in Cycas and Gnetum it is persistent, and often of very great length, in such the radicle is said to have an organic connection with the seed. M. Brongniart states that the embryo sometimes becomes isolated from its attachment at an early period, this is probably due to manipulation.

In the only two instances I know of in which no nucleus exists, the radicle corresponds to that part of the embryonary sac nearest to the base of the style, and this is in both these cases the base of the sac itself. Hence it may be stated, that the radicle always corresponds to the upper part of this sac, viewed relatively to the configuration of the *seed*.

I have never seen an instance of such an embryo as M. Brongniart mentions in three instances, viz. the central cell being the largest, it leads him to ask if it may not be the spermatic granule !

Of the direction of the cotyledons with regard to the faces of the seed I can state nothing positive, they are often alternate, and as often opposite to the true faces of this body, and I am acquainted at least with one instance in which, though originally opposite, they have become alternate to these faces during their development.

The modifications undergone by the cotyledons during their development require examination. I allude to their occasional crumpled state, etc.

All cases of single cotyledons among exogenous plants are due to their mutual cohesion, which in no instance perhaps extends equally throughout their extent. A slit will be visible near the collet, and on either side of the embryo as in

Loranthus. Even the cotyledon is not absolutely essential, as is proved by Stylocoryne.

With respect to the correspondence of the different parts of the embryo with the envelopes of the seed, it is almost needless to observe that the radicle almost invariably points to the situation of the foramen. The cotyledons correspond to the chalaza.

M. Brongniart p. 116, has endeavoured to work out more correspondences, and arguing on unequal development as indicated by a certain amount of laterality between the chalaza and apex of the nucleus; he is of opinion, that he can determine the position of the embryo, by the relative positions of the chalaza and apex of the nucleus (mamelon d'impregnation.) He gives an exception in Commelineæ, but explains it away on the grounds of the minuteness of the embryo, as compared with the bulk of the nucleus.

On similar grounds his second position, that the curved or rectilinear figure of the embryo may be inferred from the figure of the nucleus, becomes invalidated. For it is at once obvious, that taking even the maximum amount of curvature known, it will never influence the form of a minute embryo. And I believe, I can cite a case in point in Stauntonia.

The explanation upon which M. Brongniart's 3rd position is founded,* although perhaps applicable to the cases he has cited, is not so, to certain Polygoneæ in which the embryo is lateral, although the correspondence between the chalaza and apex of the seed, is as directly opposite as could be wished.

Several points connected with the growth of the embryo require investigation, viz. crumping of cotyledons, the embryo of Barringtonia, and of Myrtaceæ, Guttifera, etc. in which it is a homogeneous mass.

* [Cotyledons aborigine distinct; subsequently unite, often always a double slit.]

Gossypium.

The changes that take place are the ordinary ones, as will be seen from the accompanying sketches Pl. 51. I have not been able to trace the actual development of the coats.

The uppermost ovules are developed first, at least so far as the changes consequent on fecundation are concerned.

The development of the hairs of the testa commences a little before the time of expansion, and consists of a simple elongation of the cells of its surface.

In the early stages of the flower, the ovaria are completely enclosed by the tubus stamineus, and the anthers are attached to this by means of short stalks. It would appear hence, that owing to the very early period being incompatible with such a high degree of union, that the tubus is nothing but an elevated torus, and not due to the union of the filaments.

When the capsule is 3½ lines long, the nucleus presents an inner cavity, which has that smooth shining aspect, which I believe arises from its being lined by the embryonary sac, although the existence of this, from its extreme tenuity is very difficultly demonstrable. The cuticle of the nucleus at this period is almost separable by dissection.

Some time after the expansion, and when the ovary is 4½ to 5 lines long, careful examination will detect tubes of great tenuity passing down the placenta, and one passes into each ovulum through its foramen. The styles have fallen off, their bases only persisting ; the canal is filled with an opaque grumous mass, which I consider to result from the mass of boyaux.

The irregular appearance presented by the tubes at the apex of the nucleus, is due no doubt to the resistance they meet to their entrance.

At the same time the nucleus will be found to present a tube projecting from its apex, similar in every respect to the tube forming the boyau. This adheres very firmly. Examined without pressure, it appears to be applied firmly to the apex of the nucleus, and as it were, flattened out. Pressure, however, demonstrates beyond a doubt that it does

penetrate into the substance, and to a considerable depth; it terminates in a rounded cæcum.

They were examined by three excellent triplets of $\frac{1}{18}$ $\frac{1}{55}$ $\frac{1}{40}$.

All those I examined, amounting to 5 or 6, appeared to be either entirely or very nearly deprived of granules. Of the precise nature of these tubes, doubts will remain until they have been actually traced to be continuous with the boyaux. But I believe that they will be found to be torn at the summit of the projecting part. For my own part, I do not doubt that they are the boyaux.

The formation of the embryonary sac is somewhat indistinct; but I believe that it is membranous. It is filled interiorly with fluid and lax tissue, so that its parietes are with difficulty discernible.

The embryo commences to appear before the boyaux have ceased to be visible.

The other points worth notice are the great development of the tegmen, contrary to Mirbel's idea, and its evident continuation as perhaps the principal membrane of the seed.

The laterality of the embryo I have not been able to determine; subsequently it is completely pushed to one side, and might almost be supposed to be external to the embryonary sac. Its true situation will be seen from examination of the embryo at an early period.

The antitropous ovule presents some curious reflections. The instance was a solitary one, can it be that inversion was prevented by want of space? At any rate, it would seem that under certain circumstances, all forms of ovule may occur in one ovary.

Fig. 2, and especially *2 b*, prove that there is no separation of coats at this period, and that consequently Mirbel's idea as to the origin of the coats is wrong. Pressure, I say, will always demonstrate separation when it does exist.

At the time of expansion, and even after the partial application of the pollen to the stigmata, no tubes are to be discovered within the cavity of the ovary. The nucleus at this period has the usual conformation, but the cells at its apex are

lax, and, not unfrequently, present the appearance of a terminal, or the central largish one, surrounded by a ring of others somewhat smaller at its base.

But after the tubes are discoverable with facility in the cavity of the ovary, the appearance is different, for these cells are generally no longer visible, the apex of the nucleus now presents an irregular membranous tube, which is applied firmly to the apex of the nucleus, but does not appear to penetrate into its substance. This tube is the termination of the boyaux; of this the proofs are, first, its being not closed at its apex; secondly, its obvious continuation with the tubes that enter the ovary; third, its not being present before the tube has passed both foramina.

I consider it is settled that the apiculus of the nucleus of Gossypium is due to the adhesion of the apex of the boyaux. I have seen one or two instances in which the boyaux had reached the opening through the secundine, without passing it. In these, the nucleary apex was simply, loosely cellular.

Some uncertainty in sceptical minds will always attach to those cases in which the actual demonstration of the continuation of the nucleary tube, with the actual boyaux, has not been effected. And this in many cases is impossible owing chiefly to the readiness with which the style separates, about, or to wards its base, as soon as the required passage down of the boyaux has been effected. Of such Gossypium is an instance.

Were other proofs required, a strong one might be mentioned in the fact that in Cucurbitaceæ, in which the tube is actually nucleary, its evolution always takes place at a period somewhat antecedent to fecundation.

Gossypium,—Plate li.—Fig. 1.

1. Transverse section of apex of ovary.

a. a. Glandular receptacles.

b. b. b. Lines indicating the union of the carpella, or in other words, the inflections of the carpellary leaves.

c. c. c. The margins of these, forming here the continuation of the stigmatic tissue, and in the cavity of the ovary, the placenta.

d. Vascular supplies.
2. Transverse section near the apex of the ovary.
a. Glandular reservoirs; *b*. line as above, now dislocated and interrupted by the growth of the cells.
c. Placenta; *d*. vessels; *e*. line dividing the placenta, on either side of this line ovula are fixed.
3. Apex of nucleus during expansion, but before fecundation; 3 *a*. same under slight pressure.
4. 4. 4. Apex of nucleus after fecundation, or at least after the boyaux have reached the ovula; corolla not withered, or only commencing to wither.
4 *a*. Same under moderate pressure, shewing that the boyaux cannot be traced into the substance of the nucleus.

Plate LI.—Fig. 3.

1. Ovule in its very early state; bud $1\frac{3}{4}$ line long.
2. Same more developed, inversion nearly complete; bud $2\frac{1}{2}$ lines long.
2 *a*. Inner coat and nucleus; 2 *b*. same under pressure, shewing that there is no separation of structure.
3. Ovule a little less advanced, a nearly vertical view; bud 2 lines long.
4. Bud $4\frac{1}{2}$ lines long, ovule long section; *a*. testa; *b*. second integument; *c*. nucleus.
5. Ovule more advanced, hairs just commencing.
5 *a*. Same long section; *a*. testa; *b*. tegmen; *c*. nucleus; *d*. its cavity commencing; raphe half complete, sending off lateral branches.
6. Ovule more advanced.
6 *a*. Ditto long section; *a*. testa; *b*. tegmen; *c*. nucleus; *d*. its cavity as before.
7. Ovule still further advanced; 7 *a*. its embryonary sac; tegmen densely cellular.
8. Nucleus of an ovule with opaque tissue at its base, its cavity formed interiorly, and tube adhering to its apex.

8 *a*. Same, apex of nucleus $\frac{1}{18}$ triplet.

8 *b*. Same, apex of nucleus under slight pressure.

9. Same under pressure $\frac{1}{30}$. } Tube seen to penetrate

9 *a*. Same, ... $\frac{1}{35}$. } some distance in.

10. Ovule, long section more advanced, coma well developed, except about the foramen.

10 *a*. Inner tegument of ditto detached, foramen not visible.

10 *b*. Ditto long section; 10 *c*. nucleus of ditto exposed, base of inner coat remains; *a*. tegmen; *b*. nucleus.

10 *d*. Nucleus of ditto long section; *a*.* nucleary membrane to which the nucleus is now reduced; *b*.* embryonary sac collapsed in its natural state; it is filled with fluid and very lax tissue; 10 *e*. embryo of the same.

11. Embryo at the commencement of the cotyledonary division.

12. Ovule much more advanced; *a*. testa; *b*. tegmen; *c*. nucleus; *d*. embryonary sac, in its upper part cellular, empty below; *e*. embryo already lateral, ovary 10 lines long.

12 *a*. Embryo of same, adhesion of tegmen to nucleus slight, as of embryonary sac to nucleary.

13. Ovules half matured, the same letters have the same references; 13 *a*. embryonary sac detached, shewing the situation of the embryo; this face corresponds to the antiraphal face of the ovule; 13 *b*. embryonary sac viewed laterally; 13 *c*. same interiorly, funicle easily ruptured from its attachment; nucleary membrane adhering slightly to the tegmen.

PLATE LI.—FIG. 2.

1. Ovulum developed in the axis of the ovary, and outside its cavity, *a*. apex of second coat projecting.

* Reference omitted in original drawing.

2. Long section of same; *a.* long funicle; *a.* raphe; *b.* testa; *c.* tegmen; *d.* nucleus.
3. Portion of placenta, with ovula, at about similar period as No. 10 of Fig. 3; *a.* placentæ; *b.* their approximated margins; *c. c. c.* hila; *d. d. d.* foramina somewhat removed from their original positions; into them, a tube is seen to pass from the placenta.

Gnetum. The sudden appearance of the third envelope, whatever its origin may be, is very remarkable. Thus at the time at which impregnation may be supposed to take place, that is during the dehiscence of the anthers, there is no trace whatever of it. After the fall of the male flowers, and when the ovule is as large again, we find it perfect, with its styliform prolongation just exserted. I believe it to be either a new membrane or a formation from the pre-existing secundine.

It is distinct from the nucleus as far as its origin is concerned, for this last alters but little, and is always recognisable, changing but very slightly in form, the quintine, now quartine, being visible too.

The fact of this apex of the secundine projecting beyond the exostome during the dehiscence of the anthers, is another remarkable circumstance, especially when coupled with the future and much greater exsertion of the new membrane.

The study of the impregnation will be highly interesting, and will for obvious reasons, as well as that of Coniferæ, throw vast light on this intricate phenomenon.

How does the pollen exert its influence which is general enough, since many ovules in a spike are always impregnated? The great exsertion of the apex at the third membrane, and its sphacelation would seem to indicate some co-operation, but this takes place after the fall of the male flowers of the respective spikes. Besides which, the quintine has already appeared.

The whole organization is precisely the same in the three species. It is a curious fact that very little change in the position takes place in the male flowers, except in those of G. rufipilosum, in which they become per anthesin exserted as it were.

*

My view of their structure is, that the female flowers are reduced to naked ovula, which are protected by no scales. That each ovule consists of a primine, secundine, and nucleus, in which the quartine is developed at an early period, at least in G. Brunonia, that the *tercine* is a subsequent and rapid formation. The quintine is not permanent but disappears subsequently.

The male flowers are in reality diandrous and monadelphous. In an early stage the filament is divided and always has two vascular bundles. The anthers will thence be 1-celled; the cells always remaining distinct. However it will still be better to keep it in the class, Monœcia, order Monandria.

Mergui: March 4th, 1835.

Chenopodiaceæ, sp. An. CHENOPODIUM.

A branched green aromatic plant, common all about the rivers between the Berhampooter and Ganges. Sepala 5, æstivatione valvata, apicibus subinflexis. Staminibus totidem oppositis hypogynis. Filamentis brevibus imâ basi connatis, demum, antheris lapsis, elongatis, persistentibus. Antheris bilocularibus, polline globoso multi poroso. Ovario subturbinato, quasi costato vix semper apice depresso, margine post. depresso, cellulis fimbriatis. Stylos sub o. stigmatibus, linearibus setaceis 3 v. 4. Ovulo unico ascendento, foramen infraspectante. Utriculo monospermo, depresso, pericarpio membranaceo, tenuissimo. Semino subreniformi quasi transverso. Testa brunnea coriacea. Tegumino nucleari basi vestiento tenuissimo. Albumino sacci embryonali.

Embryo curvatus axilis.

The flower is badly supplied with vessels, the ovary is quite destitute of them, except one cord which passes directly into the ovule, the plicate appearance it presents may be mistaken for vessels. The stigmata are lax cellular grumous bodies, with scarcely any stigmatic tissue. The stamina are in the young state imperfectly vascular, but in the old filaments these are scarcely distinguishable, the anthers would seem

to be articulated on these. The pollen is singular: under an ordinary lens it appears reticulate, the spaces between the meshes being punctatedly opaque. This appearance under a triplet is cellular, with opaque, irregular, angular, areole; but on changing the focus these opaque parts become lucid and yellowish, precisely the same as the pores of tissue are.

The early development of the ovule I have not followed; when nearly fully formed and totally inverted, it certainly has two integuments, of which the inner is slightly projecting. This subsequently disappears, the neck and projecting part existing longest.

The first change is the formation of the nucleary cavity; at the time of expansion, boyaux may be found passing into the foramen. I think they pass directly from the base of the style; no conducting tissue observed.

The boyaux are occasionally branched, one is produced from one globule: in one instance several boyaux were anastomosed and interlaced in a curious manner, (requires further examination); the tube passes into the nucleus but a short way, in that represented; the apex of the inner coat remains.

The next change is the production of the embryonary sac, which is developed from above downwards, and is of excessive tenuity, but perfectly membranous; it is soon filled with grumous molecules, especially at the apex or rather base, where the embryo is developed. This embryo is curious, its attachment is long, conical at top, dwindling below into a stalk, this is terminated by the globular embryo. See fig. 22 for its cellular and granular composition.

Lastly, the albumen developes and occupies the whole of the embryonary sac; the nucleus has been long reduced to a thin membrane.

In the ripe seed the following parts will be seen: testa coriaceous brown, nucleary membrane lining this and of great tenuity, embryonary sac distinct at the apex, albumen, and embryo.

The embryonary sac will be at once known from the nucleary membrane if it present marks of its former attach-

ment, otherwise as in the present instance, nothing but the situation will determine it, and that only when the nucleary membrane exists.

The granules composing the young albumen are very irregular in form.

The growth of the embryo is curious, it shews evidently that the first formed cell is not that which (as might perhaps be expected) is to form the embryo, this being a subsequent development. Hence, epigynesis must be accidental: the growth does not depend on that of one or two pre-existing bodies, but new ones are formed, excited *by the stimulus* produced by the *boyaux ?*

CHENOPODIUM,—PLATE LII.

1. Alabastrum, sometime before dehiscence.
2. Ovary, etc. of ditto laid open, to shew the site of the ovulum.
3. Ovule of ditto, at this period it certainly has two coats, of which the second projects beyond the outer; nucleus solid.
4. Ovule more advanced; secundine barely, if at all, distinguishable.
5. Young fruit enveloped in the persistent unaltered calyx: 6. pistillum of ditto surrounded at the base by the persistent elongated filaments: 7. seed of ditto: 8. ditto long section; *a.* testa; *b.* nucleary membrane; *c.* embryonary sac; *d.** embryo: 9. nucleus extracted; *a.* nucleus; *b.* embryonary sac; *c.* embryo.

9 *a.* Seed more advanced; the same letters* have the same references.

10. Nearly mature utricle: 11. long section of seed; the same letters have the same references.
12. Flower laid open: 13. pistillum laid open, shewing the direction of the foramen at *a ; a.* boyaux enter it.

* Letters of reference omitted in original.

14. Same, pistillum not open.
15. Stamen, outer view: 16. ditto inner: 17. ditto after dehiscence: 18. pollen, immersed in water: 19. ditto opaque.
20. Ovule, after fecundation laid open; *a.* testa; *b.* apex of secundine; *c.* nucleus; *d.* embryonary sac; *e.* embryo; *f.** boyaux here branched.
21. Embryonary sac of ditto; *a.** embryo
22. Apex of ditto with embryo mostly included $\frac{1}{40}$.

Albumen. Perisperm. Endosperm.

This substance has been, but I think erroneously, supposed by all Botanists to exist at some period or other in every seed. For even during the first period of its deposition, its appearance is very different from that presented by the very lax tissue contained in embryonary sacs when membrano-cellular and surrounding the embryo.

In its earlier stages it consists of myriads of active molecules of irregular sizes, those mysterious bodies which evidently play so important a function in all cases of formation of new organs.

This organ is, with the exception of the few instances mentioned by Mr. Brown, invariably formed within the embryonary sac.

M. Brongniart has noticed several additional instances in which he supposes the albumen to be formed within the nucleary tissue. Of the instances given, Zea is not a true example, and from the consideration of Santalum, I would infer that even in Thesium, development of albumen follows the ordinary course.

With regard to Zea, I am of opinion, that M. Brongniart has not examined the ovula at a sufficiently early period.

This distinguished Botanist has, it appears to me, described the nucleus as the single integument, and the embryonary sac as the nucleus. It must be remarked, that from

* Letters of reference omitted in original.

the nature of the attachment of the ovulum of this plant, a transverse section near the base will shew the coats on one side only. Two certainly exist, but both appear shortly after fecundation to become adherent to the cavity of the ovary.

M. Mirbel would appear to coincide with Brongniart regarding the nucleary albumen of Zea, although his remarks are confined to the coats; but he very properly observes in opposition to M. Brongniart's ideas of his single tegument being tegmen, that many primines of other families than grasses, have no apparent vessels, pp. 49, 50.

Subsequently at page 55, he adopts Brongniart's views.

M. Brongniart's view of Mays is this, and it is probable that the difference arises from his having observed the ovulum after fecundation. The ovule, according to him consists of a thick outer coat, which he supposes to be tegmen, and a conical body, which he terms nucleus. The most curious part of the statement is the existence of an opening in the tegmen (my nucleus), in which the apex of the nucleus is engaged. The existence of the two coats before fecundation at once sets this question at rest. Even if my observations be found erroneous, subsequent experience has proved, that the fleshy mass may be nucleus. To this it has every affinity, as has the sac to the embryonary sac. He subsequently describes Gramineæ much more rightly, enfin dans certaines plantes, presque toute l'amande est formée par un parenchyme homogène, et le sac embryon ainsi ne s'offre que comme une petite cavité auprès du mamelon d'impregnation p. 107.

The albumen has been shewn by M. Raspail to consist of masses of starch, each of which is surrounded by a membranous utricle. This formation is easily seen. Mr. Brown may perhaps be supposed to allude to it, as he speaks of it as a deposition for the secretion of granular matters within the cells of the nucleus, or utricle of the amnios.

For the first precise information as to the formation of this organ, we are indebted to Mr. Brown. He distinctly points out that the albumen is formed in most instances

within the sac of the amnios, and that in other cases again, it is formed "by a deposition of granular matter in the cells of the nucleus. In some of these cases the membrane of the amnios seems to be persistent, forming even in the ripe seed, a proper coat for the embryo, the original attachment of whose radicle to the apex of this coat may also continue." Mr. Brown then alludes to this structure, as affording the best explanation of the structure of true Nymphæaceæ, Piperaceæ, Saururus, and Scitamineæ, in which the two albumens are of very different texture. Mr. Brown would appear to be of opinion, that albumen may be formed in the nucleus without the persistence of the amnios, either as a membrane or as a sac filled with albumen. But it appears to me that in no instance in which the amnios is suffered to reach its ordinary amount of growth, is there a deposition of albumen in the cells of the nucleus itself.

M. Brongniart has entirely corroborated Mr. Brown's views respecting the above formation of albumen, but some of the instances he quotes in addition, will I believe, not be found to be so in reality. Gramineæ certainly are not, and if analogy, is allowed to guide us, Thesium also is not. M. Brongniart proposes the term Perisperm for the albumen when formed in the nucleus, and Endosperm when in the embryonary sac, a multiplication of terms as it appears to me totally unnecessary.

M. Mirbel while agreeing with the correctness of Mr. Brown's views as given above, says, that although the albumen often belongs to the nucleus or to the quintine, it belongs perhaps as often to the quartine; that fourth envelope which neither Treviranus nor Mr. Brown have distinguished. There is no doubt, but it is the quartine which contains the albumen of the Tulip, of Tradescantia, and of Statice. It is again obvious that Mirbel has erred in supposing that his quintine is in all cases the amnios of Mr. Brown.

The presence of albumen is the test of an imperfect evolution of the embryo, or rather of imperfect germinating powers: does this explain why it is of such common occur-

rence in monocotyledons? Mr. Brown long ago remarked that the presence of the albumen was typical of monocotyledons, but no one has remarked that the proportion of albuminous monopetalous dicotyledonous orders to the exalbuminous, is nearly equal to that of albuminous forms among monocotyledons.* Its presence is incompatible with a highly

* *Albumen occurs in* 89, *among Polypetalous, Apetalous and Achlamydeous orders. The relative proportion being as follow—*

Polypetalæ,	....	64		
Apetalæ,	....	20	or 1 in	$4\frac{1}{2}$
Achlamydeæ,	....	5	or 1 in	17

Hypogynous stamens occur in 52, of the above number, thus—

Stam. Definite,	....	....	....	32	52
Stam. Indefinite,	....	....	....	14	
Stam. Definite or indefinite,		....	....	6	

Perigynous stamens occur in 37, thus—

Stam. Definite,	....	....	....	29	37 = 89
Stam. Indefinite,	....	....	....	6	
Stam. Definite or indefinite,		....	....	2	

Ovarium free, compound: as indicated either by the number of placentæ, cells, or composition of the styles or stigmata, occurs in the following proportions—

Polypetalæ.	Stam. Definite,	....	....	17	28
	Stam. Indefinite,	....	....	9	
	Stam. Definite or indefinite,	....	....	2	
	Ovarium simple, free: indicated by unity of placenta and undivided styles or stigma, including those with multiplex fruits—				
	Stam. Definite,		....	7	13
	Stam. Indefinite,		....	5	
	Stam. Definite or indefinite,		....	1	
	Ovarium adherent, compound—				
	Stam. Definite,		....	10	13
	Stam. Indefinite,		....	3	
	Stam. Definite or indefinite,		....	0	
	Ovary simple, adherent—				
	Stam. Definite .. Halorageæ?		....	1	1
	Stam. Indefinite,		...	0	
	Stam. Definite or indefinite,		....	0	
Apetalæ.	*Ovarium adherent, compound—*				
	Stam. Definite,		Perig.	1	1
	Stam. Indefinite,		....	0	
	Stam. Definite or indefinite,		....	0	
	Ovarium compound, free—				
	Stam. Definite,		Perig.	5	6
	Stam. Indefinite,		....	0	
	Stam. Definite or indefinite,		....	1	
	Ovarium simple, free—				
	Stam. Definite,	Hyp. 2,	Perig. 7 =	9	12
	Stam. Indefinite,		Perig.	2	
	Stam. Definite or indefinite,		Perig.	1	

developed plumula, a remarkable fact, and one particularly indicated by some Aroideæ, which contrary to the habit of

Achlamydeæ.	*Ovarium compound, adherent—*			
	Stam. Definite, ...	Perig.		
	Stam. Indefinite, ...			
	Stam. Definite or indefinite,			
	Ovarium compound, free—			
	Stam. Definite, ...	Perig.	1	1
	Stam. Indefinite, ...	Perig.	0	
	Stam. Definite or indefinite,	Perig.	0	
	Ovarium simple, free—			
	Stam. Definite, ...	Perig.	3	4
	Stam. Indefinite, ...	....	0	
	Stam. Definite or indefinite,	....	1	

Perigynous stamens are much oftener definite than indefinite. Of Polypetalous perigynism, 47 are definite, 13 indefinite, and 5 definite or indefinite. But in Apetalous orders the ratio is increased—for 22 have definite, 3 indefinite, and two *various.* Of these, 5 only have hypogynous stamens, or in the proportion of nearly 1 in 7.

Hypogynous stamens, presume, necessarily, total unconnection between the calyx and ovarium. They may become perigynous as I have shewn in Mirabilis.

Definite stamens occur in 47 Polypetalæ, indefinite in 25, and various in 4, so that the proportion of indefinite is increased in the perigynous, being one in 3, in these, rather more than 1 in 2.

Mimoseæ afford a beautiful instance of this tendency to indefiniteness in hypogynous stamens.

Again the great tendency to definition in stamens that adhere either to the calyx or corolla, is pointed out by the occurrence in Monopetalæ, of 57 orders with definite stamens; although as most of these are epipetalous, it may be laid down as a law that adhesion to the corolla has greater power in producing definity, than adhesion to the calyx. A few of these vary with hypogynous and epipetalous stamens, such as Ericeæ, and the remarkable instance of Plumbagineæ, otherwise Styracea and Belvisiaceæ are the only two in which definite or indefinite stamens occur. Hypogynism is very rare in monopetalous orders, occurring only in Pyrolaceæ and Brunoniaceæ, and Mimoseæ, and in the monopetalous Plumbagineæ, although to this latter fact, Ægialitis is an exception.

If we look to Monocotyledons, we shall find the same laws in force.

Thus out of 6 polypetalous orders, 4 have hypogynous stamens, a character perhaps totally unknown among the monopetalous orders, and of the above, 3 have both definite and indefinite, whereas in the monopetalous, Pandaneæ is the only instance of indefinity.

Mr. Brown has remarked that the presence of albumen may be considered as the natural structure of the primary division of Monocotyledons. We might be led to expect this from the knowledge of the functions of this organ, which is a test of incomplete evolution on the part of the embryo. Indeed with the more or less completion of this, does *its* size fluctuate; those with thin albumen may be looked upon as presenting intermediate stages of development. But no one has remarked that the prevalence of albumen in monopetalous Dicotyledonous orders, is nearly in the same ratio. Seven Monocoty. orders want albumen; there, the proportion in favour of albumen is about $4\frac{1}{2}$ to 1. The proportion in favour of the same among monopet. Dicot. is very nearly 4 to 1.

the order, are exalbuminous; the deficiency being supplied by a high degree of development of the plumula.

Of the seven exalbuminous Monocot. orders, 3 are polypetalous, a proportion very nearly equal to that which occurs among polypetalous Dicotyledons, the number of albuminous orders being 64, of exalbuminous 61.

The proportion is in favour of albumen in Apetalæ in the ratio of Alb. 20, Exalb. 12, or $1\frac{2}{3}$ to 1; and in Achlamydeæ it is increased to Alb. 5, Exalb. 4, or being nearly 2 to 1.

The proportion in favour of definity among polypetalous albuminous orders rather more than 2 to 1.

Perig. Defin.	20	....	Indef.	....	4	either 1.
Hypog. Ditto, ...	22	....	ditto	....	15	ditto 3.
	42	....	....	....	19	.... 4.

Hence as the proportion is otherwise so much in favour of definity in Monopet. and Monocot. albuminous orders, we may assume the existence of some connection between definity of stamens and the existence of albumen.

There does appear to be a bias in favour of the co-existence of ovar. superum, with albumen, that is, if we take the totality of the orders. Among polypetalous albuminous orders, the proportion in favour of a free ovary is 3 to 1.

Polypetalæ.

Super. calyx, ...	13
Either super. or infer.	1
Free or inf.	50
	64

Among monopetalous albuminous orders, the proportion is rather more than 2 to 1.

Monopetalæ.

Super. calyx, ...	14
Infer.	30
Either, ...	2
	46

And in monocotyledonous, the proportions are nearly equal. Taking the same total, the preponderance in favour of ovar. superum, and albuminous seeds is rather more than 2 to 1.

Monocotyledones.

Super. calyx, ...	13
Infer.	14
	27

I believe that the future existence of albumen may be ascertained by examining the ovulum, and that its presence is linked with a *membranous* embryonary sac. The distinction between these is very evident: take for instance the embryonary sac of Compositæ which is cellular, and that of Santalaceæ. The only exception I know of to this occurs in Loranthus, but this is so parodoxical in every point regarding the evolution of its seed, that it can scarcely be said much to invalidate the rule.

Both perigynous and epigynous stamens, which last are only the maximum of perigynism, except in Raspailia, are (but not necessarily) linked with the existence of

Ovulum in its earlier stages.

A vegetable ovulum is, at its earliest period of existence, a mere extension from some part of the surface of the placenta; it is at this time a rounded sessile, entirely cellular, homogeneous body, not exhibiting any trace of teguments.

The first change that takes place consists in the separation of this body to a greater or less extent from the placenta, by the elongation of a portion of this, forming the commence-

an entire calyx, which in the last instance adheres to the ovary. In the former it may adhere or not, but the adhesion is only partial.

Hypogynous stamens presume the existence of an inferior calyx and corolla, but they are not linked with any distinction of, or coalition with the parts of the outer floral integuments, although a monopetalous corolla generally induces epipetalous stamens. Indefinite stamens are to be looked for as abnormal, and hence their comparative rarity: they are almost unknown in Monocotyledons, of which there is not one order so characterized. Taking the aggregate of Polypetalæ, Apetalæ and Achlamydeæ, they are about in the proportion of 1 to 8.

A monopetalous corolla may be almost said to require definite stamens; for we are not to take into account those cases in which cohesion of the bases of the petals takes place through the means of indefinite stamens, as in Stravadium, Careya, etc.

Ovarium inferum, with the exception of a few instances requires a composite ovarium. I think Mr. Brown says that he is not acquainted with any instance of a truly simple ovarium being inferior, or adherent to the calyx: so that it is very probable that Dipsaceæ, Calycereæ, Loranthaceæ, Balanophoreæ, Combretaceæ and Halorageæ? may present some indication of composition. The number of vascular fascicles of the style in such cases is of the utmost importance, as are likewise any traces of division of the stigma. The absolute value of the former character still requires to be estimated, as in Boragineæ; in which, if the received opinion about the number of composing carpella be correct, there should be 4 fascicles, whereas there are only 2. Mr. Brown has likewise shewn that in some Dipsaceæ the unexpected combination of "flos superus" with "ovarium liberum" does take place. It is likewise well worth considering whether simple ovaria are not always more or less oblique; such is the case very evidently in Leguminosæ, Ranunculaceæ, Rosaceæ, Ochnaceæ, etc. etc. and such is universally the case if we look at the component parts of ovaria in Compositæ. If this be true then, none of the above instances, nor many of those of non-adherent fruits, such as Laurineæ are simple, except by abortion.

The proportion of adherent ovaria, to perigynous stamens with free ovaria, is about 1 to 3, but exalbuminous orders amount to 53, and the adherent are only 10. In the albuminous orders, there are only 21, of which 13 are adherent.

Of Monopetalæ the proportions with adherent ovaria, are as 1 to 3½, and of these 14 are albuminous. Apetalæ are characterized in some degree by a prevalence of perigynous stamens, and far more have definite seeds; to such an extent is this carried, that about two-thirds of the whole have them so.

Jussieu says p. 87. Gen. Plant. Curin staminibus hypogynis multó rarior quam in perigynis hac Apetalarum ad Polypetalas accessio?

Achlamydeæ are similarly characterized, so far at least as the latter character is concerned.

ment of the funicle. The next changes are the marking out of the subsequent coat or coats, by one, or very generally, two lines of constriction, the uppermost of which appears to me to be formed first.

When two lines are formed, the ovulum will be divided into three parts, the uppermost and pre-existing one forming the nucleus, that between the lines giving origin to the second or inner tegument, that between the lowest line and the base of the ovulum, in a similar manner giving origin to the outer membrane, or testa.

In other words, each of these rings, for such is very frequently their appearance, becomes elongated upwards.

But while these changes in the growth of the ovulum are going on, other changes of a secondary nature sometimes take place; consisting very frequently in a sort of inversion, whereby the apex of the nucleus instead of being directly opposed to the attachment of the ovule, is brought to point towards it. To this subject I shall again refer.

The production upwards of the ring marked out between the lines of constriction, or if one line only is visible of the part contiguous to that line, continues, and the base of the nucleus becomes surrounded by a shallow annular cup. Very shortly afterwards, that which subsequently becomes the outer coat, is similarly extended round the base of the second, or inner one.

Both these continue to elongate, but the inner one maintains for some time the ascendancy, and at length encloses the nucleus, beyond which it is generally continued into a neck, variable in length, always open, and generally somewhat dilated at its extremity.

A similar preponderance takes place to a greater extent in favour of exalbuminous monopetalous orders; the proportion being 10 to 14, or 5 in 7.

Epigynous stamens are always definite, this was pointed out long ago by Jussieu, in his immortal Genera Plantarum. Perigynesis determines nothing beyond a degree of union of the component parts of the calyx, and a perigynous insertion of the corolla when present. Hypogynism determines necessarily an inferior calyx, and consequently a superior ovarium, but it does not follow that an inferior calyx is associated with a free ovarium—Goodenoviæ and Cyclacodon nob. a genus of Campanalaceæ.

The outer coat by its gradual increase, at length likewise encloses the nucleus and the body of the second integument, (exceptions occur in Ricinus, etc.) not unfrequently it entirely encloses this latter.

Throughout the above period the nucleus has continued to increase in size, generally it becomes completely covered by one or both coats, in other instances again, its apex projects beyond the openings of these, to a greater or less extent.

At the time of fecundation an ovulum will generally be found to consist of an outer coat, open at its true apex; (the opening varying in size, but being always less than the diameter of the body of the ovule;) of an inner cellular coat, generally thinner than the outer, prolonged beyond the nucleus in a hollow neck, the apex of which is more or less dilated and occasionally almost fimbriated, and which is generally on a level with the mouth of the opening of the outer coat, occasionally, however, projecting beyond it, even to a considerable distance.

Lastly, of a central cellular body, the nucleus, generally more or less ovate; its apex more or less conical, being of a more lax tissue than the remainder, and projecting occasionally beyond the opening in the coats of the ovulum.

This body will, at the period alluded to, generally present a central discoloured nucellus, or frequently even an excavated sub-central cavity of variable dimensions. The discoloration alluded to, or rather opacity, is invariably the precursor of the cavity that is to be formed, and which is generally formed from below upwards.

The ovulum at this period may be entirely cellular, or it may be variously supplied with vessels, but on this point I shall remark more fully when speaking of the raphe.

The opening of the integuments may be variously situated, either directly opposite to the point of attachment of the ovule, or at one side of it. Of this latter instance, there are two modifications. I shall have occasion hereafter to revert to this subject.

All the subsequent changes at least those of any importance are carried on within the nucleus. They consist first of an extension of the cavity above mentioned, until with the exception of some few cases hereafter to be specified, this originally thick, solid, cellular body, is reduced to a thin coating, often so thin as to be with difficulty detectable.

The cavity thus formed will be found to present at its base or apex, a vesicular body which enlarges rapidly, and soon lines the whole of the cavity, and tends by a continuance of enlargement to reduce the nucleus to the thin coat above mentioned. This sac soon becomes more or less filled with lax tissue, which subsequently is either absorbed or converted into albumen.

The last change, and the only one actually dependent on fecundation, consists in the development of the embryo, which invariably takes place at that part of the embryonary sac nearest to the apex of the nucleus, at least when the development is carried on within this body.

Before concluding the detailed consideration of the parts forming an ovule, I must observe that M. Mirbel and Mr. Brown differ as to the mode of formation of the teguments. M. Mirbel says, in his 1st Memoire, p. 4. "dans l'origine, l'ovule n'est qu'une petite excroissance pulpeuse qui ne parait avoir aucune envelope, aucune ouverture. Peu après, le point culminant de la petite excroissance se perce, et l'on commence à distinguer l'exostome, et l'endostome, et à la faveur de ces deux orifices, la primine, la secondine, et la nucelle." It is rather difficult to comprehend the precise meaning of this passage, Mirbel says likewise, that the primine is formed first, and he figures it as being so ; see his Mem. pl. 1, fig. 3, Cucumis Anguria : this is in my mind, the inner tegument, or his secundine, at least to reconcile it with the excellent figures given by the same author. Mr. Brown's explanation is much more conformable to what actually takes place, and I have adopted it without hesitation.

I have before alluded to a change of situation frequently occurring in the ovulum in its earlier stages of growth. For a due knowledge of this we are indebted to M. Mirbel.

According to this author, all ovula are originally orthotropous; that is, the opening of the teguments, and consequently the apex of the nucleus is directly opposed to the base of the ovule as indicated by its point of attachment to the placenta, either directly, or more frequently, indirectly.

In many cases this correspondence continues in the ripe seed, no change whatever having taken place; and such form what M. Mirbel calls antitropous ovula.

In all others a change does take place. In one modification, the change is accomplished by a mere curvature, which causes the apex of the ovulum to be approximated to the base, or point of attachment. Such constitutes M. Mirbel's campylotropous ovule.

In others again, change is effected by an actual change of position in the base of the nucleus, now no longer corresponding to the point of attachment of the ovulum. This forms M. Mirbel's anatropous ovule, and it is the most frequent form.

M. Mirbel has proposed another class; which he calls amphitropous, and which differs only from the anatropous form in the shortness of the raphe, from which it results that the chalaza is lateral with respect to the geometrical apex of the seed. The distinction is, I think, needless, since the chalaza still corresponds to the base of the nucleus.

M. Brongniart, at p. 72, notices another modification, in which without any curvation, or *un repliement réel,* in the membranes of the ovulum, the foramen is approximated to the hilum, as in Chenopodeæ, Amarantaceæ, etc.

M. Mirbel has well shown that anatropism is not necessarily dependent upon a change of position, for he has shewn satisfactorily that in a few instances it results from unequal growth.

See his observation on Quercus, Alnus, Corylus; Memoire p. 45, pl. 8.

And on Primulaceæ, and Plantagineæ, p. 47, pl. 10.

These anomalies are curious and well worth notice, as they perhaps give rise to all those forms of anatropism, in which there is no trace of a raphe visible.

I have only one observation to make further, with reference to the correspondence of the earliest stages of the ovulum, with those of the other parts of a flower.

M. Mirbel has observed, Memoire 1, p. 7, pl. 1, fig. 2, that the amount of development varies even in the ovules of one placenta, but the extent in the instance cited would appear to be inconsiderable.

In almost every case these correspond to a very early period of development of the ovarium, and a still earlier one of the corolla. And the only instance I know to the contrary is Stauntonia, in which casual observations lead me to infer that they correspond to the period of expansion of the flower.

M. Brongniart mentions that in Corylus avellana, the ovula are not perceptible, even at the period of fecundation. [Memoire, p. 65, pl. 8, fig. 5, said to be taken from an ovary very young.] But this does not seem to be corroborated by M. Mirbel.

Instances are not wanting in which the ovule is actually absent before the completion of fecundation, at least such is my view of the structure of Viscum.

Raphe.

The vascular supplies of the ovule and seed, present themselves under various aspects. In all cases they are supposed to belong to the outer coat. In some instances their course is distinctly within the tegument, in some however, in which especially the nucleus adheres intimately to the tegument, the cord appears to run between the two, this is very evident in Cucurbitaceæ.

All ovula are aborigine, entirely cellular, conforming in this respect, to every other part of a vegetable when examined in a sufficiently early stage, and instances are by no means uncommon where such is the case in the matured seed; and perhaps, incompletion until after fecundation, is the general fact.

Further observations are wanted, to determine the exact period at which the vessels of the placenta, are prolonged into the ovule.

M. Mirbel says, that the raphe is developed with the primine at the moment of change of direction, and that it exists only in anatropous ovula. Memoire 1. p. 4. To this I do not agree.

Of those which are vascular, some, as in the case of antitropous and campylotropous ovula of Mirbel, have their vessels limited to a thin fascicle, which passing in at the base of the ovule, finds itself almost immediately in contact with the base of the nucleus; at, or about which it terminates. It is in such instances that difficulty arises in distinguishing the nature of the coat, when this is solitary. In others again, in addition to the supply for the nucleus? vessels may be variously distributed over the outer coat, as in Myrica, etc.

The vascular supplies have, it would appear, been generally supposed to be most complete in those ovula, (and they are the most numerous,) in which the base of the nucleus is removed as it were, to a greater or less distance from the point of attachment of the seed, or ovule.

But this is not the case always, for even among these, instances of evascularity occur. And it is owing to this, that some confusion arises as to the precise meaning of the term raphe, which is limited by Botanists to this class of ovula.

Mr. Brown speaks of it as "the vascular cord of the outer coat," Mirbel, as that portion of the funicle united laterally to the outer coat, and apparently without reference to its vascularity, or evascularity.

I would understand by the term raphe, that obvious continuation of the funicle, visible on one side of the ovulum, or seed, whether vascular or not, and from which it will, in all cases, be known by the greater elongation of its tissue.

The termination of this raphe is supposed to form the chalaza, at or near the base of the integuments. [M. Mirbel has noticed, but only in Labiatæ, apparent laterality of the chalaza, he regards it as an incompletion of anatropism, p. 43.]

But although in all instances of a vascular raphe, perhaps a direct communication is established between the placenta and base of the nucleus, around which, in some instances, the ultimate vessels would appear to radiate, such does not

always form the most obvious termination of the vascular cord itself.

Thus, in several instances, the obvious termination of the vessels is at or near the foramen, as in many Compositæ, and Marlea. In others, it becomes ramified near the base of the seed, or chalaza, the ramifications tending towards the foramen.

In some, the place of vessels is supplied by a membranous tube, of this Sphærocarya is a notable instance.

The vascular cord forming part of the raphe, consists of spiral vessels and ducts, or of ducts alone, as in Cucurbitaceæ, etc.

The situation of the raphe, may be regarded as universally next the ventral suture of the carpellary leaf, or in other words, next the placenta. For this important fact we are indebted to Mr. Brown, who has likewise shewn that all, exceptions to this, are only apparent, and originate in a torsion of the funicle. Nor is this all, the same illustrious Botanist has brought the situation of the raphe into play as a character, for he has shewn that true Lonicereæ, may be at once distinguished from their allies by the reversion in the situation of the raphe. And in this point of view the consideration of the situation of this organ is useful, as proving that in Boragineæ the ovaria are inverted, while in Labiatæ they are erect.

There is no appreciable difference between the development of the ovulum in the two grand divisions of the vegetable kingdom.

The only absolute difference exists in the development of the embryo—the preliminary steps being the same in both instances.

The materials from which the foregoing account is drawn up, have been in my possession for some time.

It may be considered presumptuous to give an account of phenomena, which have engaged the attention of Mr. Brown, M. Brongniart, and M. Mirbel, the accounts of all of whom would seem to have been generally adopted, although that of M. Mirbel, is materially different from that of Mr. Brown.

And it is in the hopes of strengthening, if indeed they need any aid on my part, the views of Mr. Brown, and of reconciling the discrepant portions of M. Mirbel's account, that I have ventured to offer these observations.

HYDROCOTYLE,—PLATE XLV.—FIG. 1.

The ovula of this genus have only one coat, to which the nucleus is firmly adherent, forming a congruous fleshy mass. The foramen after fecundation is covered up by an elongation of the contiguous part of the funicle, from which cellular growths often proceed. About this time a cavity appears in the centre of the ovule, which is produced from the base upwards. This cavity is lined by a very fine *membranous* sac, which gradually extends upwards, and forms a continuation with the apex of the nucleus, which, from cohesion, is barely distinguishable. In it the albumen soon begins to be developed. The embryo is of comparatively late appearance. The raphe at the time of fecundation is about half developed. The testa is excessively thin: in the nearly ripe seed, the raphe is semi-complete.

1. About the period of fecundation.
2. Before expansion of flower.
3. After expansion.
4. Very early period; no raphe.
5. Commencement of embryo; albumen complete.
6. Nearly ripe seed.
7. After fecundation, sac filled with a grumous fluid; the commencement of the albumen.

Suddyah: 10th June, 1836.

MARLEA *begonifolia*,—PLATE XLV.—FIG. 2.

In this the nucleus has only one coat, to which it adheres firmly: with the raphe which is complete and unbranched,

running along, or nearly so, the line of union. Sometime after the lapse of the corolla, &c. a cavity will be found in the axis of the nucleus reaching from near its base above the middle: a line will be likewise seen running from its apex to the apex of the nucleus, indicating its future extension. Sometime after, it occupies the distance between both these points. It does not appear to be lined by a membrane. To it a cellular sac would seem to be attached, itself adhering to the nucleus; if so, it is an exception to my opinions as to the existence of albumen being linked to that of a membranous albumenary sac.* Most probably the albumen in this genus is developed with the nucleus, and if so, it is not an exception. The embryo is of very late appearance.

The embryonary sac is united by both ends to the cavity existing in the nucleus. The cotyledons are developed opposite the raphe; the osseous part of the fruit is the indurated ovary, and may be easily mistaken for an indurated testa. The parietes of the embryonary sac may be mistaken for a distinct membrane.

Suddyah: 12th June, 1836.

IMPATIENS *tripetala*,—PLATE XLV.—FIG. 3.

The ovula are campylotropous: of the second integument which at an early period is distinct enough, no traces are discoverable a short time before the expansion of the flower. At the time of expansion the nucleus scarcely projects beyond the foramen. The embryonary sac is pendulous or affixed to the apex of the nucleus, it rapidly enlarges and soon obliterates the nucleus: the apex of which, however, is discoverable up to a rather late date, capping the apex of the sac, which is cellular-membranous. The embryo appears early: and although at an early period the cotyledons are parallel to the broader faces of the seed, yet I think that ori-

* See note page 176.

ginally the notch, indicating the future division, runs across the short diameter, in other words, that the lobules are parallel to the true faces. No raphe appears to be developed. The testa subsequently becomes villous.

The anthers at a very early period, and when they are sessile, contain a grumous opaquish mass, in which are interspersed minute globular granules: the mass itself appears to be formed chiefly of very minute granules, but at a little more advanced stage, it is perfectly formed, consisting of oblong granules, some of which are binarily divided across their short diameter; they are occasionally, though rarely, of all sizes.

At the second stage, the mass consists of globular diaphanous hyaline vesicles, held together by the grumous matter: the opaquer globules still exist. Grumous matter is soon developed within the vesicle, which continues to increase until the vesicle is rendered turgid.

At the third stage a distinct transparent nucleus is visible, formed within the grain. The original grumous matter being pushed by the growth of this to the circumference.

In the fourth stage the granule has resumed its original appearance, but is larger; it henceforward undergoes no other change but that of increase of size. The second nucleus is most probably to be considered as the commencement of the second membrane. This is another instance of formation by enlargement of an originally simple granule.

Suddyah: 11th June, 1836.

ADENOSTEMMA,—PLATE XLVI.—FIG. 1.

Ovule developed as in other Compositæ. Raphe at the time of expansion rather more than semi-complete, situated with regard to the flower internally, externally with regard to the capitulum, and to the right: nucleus confounded with the single integument, subsequently reduced to nothing.

Embryonary sac pendulous: traces of its attachment visible up to a very late period, perhaps always at its apparent apex, but real base; distinctly cellular, separates in the ripe seed from the testa which adheres to the pericarpium, so that four layers are demonstrated surrounding the embryo; calycine pericarpal testa, and embryonary sac. Raphe subsequently nearly complete, perhaps quite so, but owing to adhesion, this is difficult to determine; embryo soon loses its attachment; radicle, as usual, developed first.

Cotyledons parallel with the raphe.

Suddyah: 11th June, 1836.

PIPERIS *sp.*—PLATE XLVI.—FIG. 2.

The ovarium is simple only by abortion, since there is always more than one stigma, generally four.

The ovulum is erect; the foramen at its apex, and corresponding exactly to the termination of the stigmatic canal, which indeed it closes inferiorly. It has two coats, the outer one being very laxly cellular, and thick; the nucleus is broadly ovate, almost cordate: with a brown spot towards the centre, in which the tissue is commencing to be dislocated and absorbed.

After fecundation, the outer tegument becomes very thin, the second is still of considerable thickness; the nucleus corresponds exactly to the cavity of this, is large and fleshy; its apex is hollow and covered only by the proper membrane of the nucleus. From its extreme apex the embryonary sac, which is very minute, is seen hanging, attached by a broad and short cell, it is itself a membranous sac, perfectly globular, and as it were, turged with grumous matter.

a. Long section after fecundation.

b. Long section of nucleus.

c. Ditto of ovulum.

d. Ditto of ovarium.

e. Ditto of apex of nucleus.
f. Ditto of nucleus entire.
g. Ditto, portion of the membrane, with the embryonary sac hanging from its apex $\frac{1}{20}$.
h. Sterile ovulum.

Suddyah: 17th June, 1836.

THYMELIA,—PLATE XLVI.—FIG. 3.

At a period long after fecundation, the nucleus has nearly disappeared; traces of it are still visible, however, adhering to the apex of the embryonary sac.

The upper half contains the densest albumen, and this fills the cavity of the testa, the remainder consists of a very lax congeries of very irregular cells: the mass tapers to a point, and is connected to the base of the seed by numerous irregularly articulate threads, this part does not fill the testa; the raphe is complete; the cotyledons are alternate with it.

The cells forming the lower half of the embryonary sac may be observed in every stage of development; form hyaline, minute empty sacs; larger sacs filled with granules, which finally become very large, containing apparently rudiments of cells, at any rate they are tumid at various points; the raphe consists through about its upper two-thirds of opaquish tissue, containing a central fascicle of short unrollable ducts: the lower one-third has no ducts.

Suddyah: 2nd August, 1836.

POLYGONI *sp.*—PLATE XLVII.—FIG. 1.

Ovule anatropous, coats two. The second soon disappearing except the mouth, which suffers scarcely any pressure.

At the time of fecundation this is the only portion of it visible, the outer coat adheres slightly to the nucleus, which is apiculate; the point cellular, scarcely projecting beyond the foramen. At this period the membranous embryonary sac is fully developed, and is attached to both ends of the nucleus. Soon after, the embryo is visible, occupying the axis of its apex. The nucleus is at this time reduced (except its base, which remains thickish) to a very fine membrane adhering to the outer coat. The albumen is developed round the embryo. A little later, and the embryo has become lateral. The cavity prepared for it being much larger than itself, and extending half-way down, and bounded on one side by the integument, on the other by the albumen. The subsequent changes will be at once understood, but it is difficult to comprehend the cause of the unequal deposit of albumen, to which I am inclined to refer the change of situation of the embryo. The *raphe* is visible at the time of expansion, but not much earlier.

a. Before fecundation.

b. During fecundation.

c. Embryonary sac with base of nucleus.

d. After fecundation of embryo.

e. More advanced, embryo commenced to be pushed to one side.

f. Early period, sometime before expansion.

Suddyah: 13th June, 1836.

STYRAX *sp.*—PLATE XLVII.—FIG. 2.

1. Longest section of ovule sometime after fecundation, the nucleus and testa adherent: abundance of spiral vessels being interposed. Superficies of nucleus green. The excavation is large, and communicates with its apex, it appears to be lined by a sort of membrane, but probably this is merely owing to the tissue of its parietes being in a state of decomposition.

Embryonary sac, now fleshy: filled with young albumen: attached by its base.

2. Ditto, the cap is at this period imperfectly formed, probably by a condensation of the tissue, dislocated in the neck of the excavation.

3. Ditto, more advanced, the apex of the embryonary sac is seen to be lodged in a sort of cup.

4. Apex of the embryonary sac, long section.

5. Long section or internal structure of cup, (by pressure) its margin appears to run into the decomposed tissue mentioned above, as lining the nucleary excavation.

6. Embryo rudimentary, developed in a single cell, but not occupying it all.

It was too late to ascertain precisely whether the embryonary sac is, aborigine membranous.

Suddyah: 8th July, 1836.

SAMBUCUS,—PLATE XLVII.—FIG. 3.

Nucleus and testa adherent: no raphe exists at the time of expansion.

The embryonary sac is distinctly membranous, and is visible shortly after the fall of the corolla, and probably before. When the young fruit is a line long, it is very distinct, attenuated at both ends, and shews signs of division, being rugose externally. It contains numerous granules. It is at this time very easily separable, although at an early period it is attached tolerably firmly by its base. It is occasionally at that time capped by a small cell, when this is the case, the greater portion of this cell becomes enclosed by the growth of those next it.

a. Shortly after the fall of the corolla.

b. Embryonary sac of the same.

c. Ovary, a line long.

d., *c.* } Expansion.

Suddyah: 30th June, 1836.

XANTHIUM *indicum*,—PLATE XLVIII.—FIG. 1.

The development of the ovule is perhaps quite the same as in Compositæ. The nucleus and its coat cohere intimately. The embryonary sac is visible before fecundation, and when the stigmata are just becoming exserted, it is then very small and cellular, the cells being very lax. About the time of fecundation, an excessively fine cellular sac, having the same attachments, will be found lining its cavity, both continuing to enlarge simultaneously until about the fall of the styles, when the embryo commences to be developed. At this period the inner sac is scarcely demonstrable. The embryo is as usual developed at the apex of the embryonary sac, its divisions are opposite to the raphe. The raphe is turned outwards from the axis! the foramen *consequently?* inwards, and it always maintains this position. As the styles indicate a pistillum simple *by abortion*, this situation of the raphe would lead us to conclude, that it is the outer cell of each ovarium that is abortive. The raphe is visible at a very early period, it subsequently ramifies over the chief part of the testa.

The pollen at an early period, when the filaments are about two-thirds shorter than the anthers, consists of globules of considerable size, held together by a grumous matter. The fibres of the cells of the endothecum are commencing their development.

a. Before fecundation, at exsertion of apex of stigma.

b. b. Embryonary sac of same.

c. At fecundation.

d. Inner sac.

e. After fecundation, before fall of styles.

f. g. Fall of style, commencement of embryo.

h. Long section to shew the site of the raphe.

Suddyah: 12th June, 1836.

SIEGESBECKIA *orientalis*,—PLATE XLVIII.—FIG. 2.

The ovula have the usual development. The embryonary sac, (lining which I can observe no other sac) is developed a short time before expansion of the flowers. At the time of exposure to the male influence, the raphe is nearly completely developed : it sends off a branch on one side, and divides about half-way round the opposite side of the ovulum into three or four branches, which terminate towards the outer lip of the foramen. It is external with regard to the axis : with regard to the absence of the inner lining of the embryonary sac, it is obvious that the same appearance would result from the sac being hollow. I have not hitherto ascertained its existence in any Compositæ. The cotyledons at the epoch of maturity alternate with the true faces of the seed ! I have not ascertained their situation in the young state, the embryo being at this time movable by the slightest pressure. It is obvious, however, that where the embryo is exalbuminous, or in all cases where it fills nearly entirely the cavity of the seed, the cotyledons must be parallel to its broader faces. Both teguments separate with the pericarp. The cells of the inner are grumous, with a central and diaphanous nucleus. The nucleus only exists at a late period.

a., *b.*, *g.* } At anthesin.

c. Outer tegumen, showing the relative situation of the ramification of the raphe to the cotyledon.

d. A little before anthesin.

e. Long before anthesin.

f. At anthesin.

Suddyah : 18th, 1836.

SPILANTHES,—PLATE XLVIII.—FIG. 3.

Ovule as in other Compositæ, but the cellularity of the embryonary sac is less discernible.

About the time of development of the embryo, the raphe is complete. The cotyledons are originally opposite the true faces. The pericarpium very early becomes black and brittle; it is reticulate, the meshes being penetrated. They are, however, closed in by the cellular paries resulting from the adhesion of the calyx with the ovarium; *b.* Pericarp.

Suddyah: June 30th, 1836.

VERBENACEÆ, VOLKAMERIA,—PL. XLIX.—FIG. 1.

Carpellary leaves anterior and posterior; style with two vascular fascicles; ovula two to each cell, pendulous from above the middle of a fleshy bilobed placenta, and from the inner side of the lobes; antitropous, raphal side next the axis; foramen scarcely distinguishable.

Coats and nucleus confounded. Embryonary sac even at a very early period cellular, attached by its base, to the base of the ovulum, but rather close to the funicle. This enlarges and subsequently makes a communication with the apex of the nucleus, or the part which corresponds to it. Embryo developed a little below the apex of the sac, inverted.

Raphe even at a late period not developed.

[*a.* During expansion.

b. Corolla equalling the calyx.]

c. c. c. c. Foramen.

Suddyah: June 11th, 1836.

CURCUMÆ *sp.*—PLATE XLIX.—FIG. 2.

In Curcuma, the ovula are crowded together chiefly towards the lower portion of the placenta, their raphal surface being next to this. At a long period before expansion, the foramen

is nearly as much closed as it is subsequently, but it has not yet began to assume an arilloid form; the secundine membrane projects beyond the foramen slightly. The nucleus is entirely enclosed, and the central tissue is dense and brownish. During expansion, the foramen has become more fleshy and lobed, and looks somewhat like an arillus: it is, however, open, and out of it passes to a considerable distance, the neck of the second membrane; scarcely any change has taken place in the nucleus. After expansion, and when the perianth has *marcesced,* the foramen is more arilloid, and much less open; even now the apex of the second coat projects slightly. No change worth mentioning has occurred in the nucleus.

The pollen is perfectly formed at a very early period.

[*a*. Sometime before expansion.
b. Just before expansion.
c. After expansion.
d. Long before expansion.]

Suddyah: June 29th, 1836.

COMMELINÆ *sp.*—PLATE XLIX.—FIG. 3.

The ovula of this genus are anatropous, but somewhat obliquely, the foramen not being immediately opposite the hilum, which is linear, and of considerable extent. The two coats of the ovule are distinct, and the neck of both are inflected over the somewhat conical neck and head of the nucleus, which they embrace firmly. The only peculiarity in this inflection is, that it is transverse, and not longitudinal (although still vertical): hence the removal of the foramen from any immediate communication with the conducting tissue of fecundation sometime after expansion, then excavation is commenced at the base of the neck of the nucleus: and at a later period this nucleus will be found reduced to a thin membrane, adherent slightly to the second coat: it is

lined by the membrano-cellular embryonary sac, which is fixed by a broad base opposite to the hilum. It is within this that the albumen is developed, and within its neck, which is prolonged into that of the nucleus that the embryo first appears. The second coat is persistent, and subsequently becomes indurated : it is lined by the nucleary membrane, so that it may almost be said to consist of debris, only the albumen is contained within the embryonary sac, which is likewise very thin. No change takes place in the foramen during the maturation of the seed. I at first thought it obvious from this, that monocotyledones did not agree with my idea that the existence of albumen is always linked (except in cases where a vitellus exists,) with a membranous embryonary sac. But I subsequently found the embryonary sac to be membranous in this species, as may be seen fig. i.

a. Just before expansion ; m, hilum.
b. Shortly after expansion.
c. Half of the testa, base of the second coat, and nucleus.
e. Commencement of excavation.
f. Embryonary sac developed.
g. Sometime after marcescence of perianth.
h. Long after.
i. Embryonary sac shown to be membranous, its cellular appearance resulting from the development of cells in its interior ; embryo just appearing.

Suddyah : July 1st, 1836.

SPERMACOCE *sp.*—PLATE LXI.—A.

Spermacoce has its ovula but little developed. They resemble much those of Asclepiadeæ and Apocyneæ and Gentianeæ, but the groove, if it exists, can scarcely be ascertained to do so. Like the above they consist of a cellular mass, most probably due to the cohesion of the nucleus with the

outer integument. Before fecundation there is a cavity towards the centre, but they are so minute that I have not been able to ascertain whether the embryonary sac, which certainly is very conspicuous afterwards, exists or not; neither have I ascertained its attachments. When the seeds are half ripe, the membranous nature of this is very distinct. No raphe exists even at this time. The cotyledons are parallel to the true faces of the seed.

1. Very early.
2. At expansion.
3. After fecundation.
4. Half dead.
5. After fecundation.
6. Sac separated.

Suddyah: June 11*th*, 1836.

PLATE LVII.—G.*

In the earliest stage I have examined these ovula, I find them to have one tegument, which is very thick. The nucleus is excessively small, its apex reaching to a level with the opening in the tegument. Shortly after, and when the corolla is one-third shorter than the calyx, the nucleus has become entirely enclosed: the foramen nearly closed, and *its canal* narrow. Just before expansion the centre of the ovule which is already somewhat reniform, is occupied by an excavation, which is in fact the nucleus, excavated and reduced to a membrane: of this, however, I have no proofs, as it adheres so firmly to the coat that I have found it impossible to dissect it away. At expansion, the apex of this sac will be seen to contain a minute globule, probably the rudiment of the embryonary sac. Shortly after, the nucleus has disappeared, and its place is occupied by a cellular body, which I take

* MS. title of drawing injured.

to be the young albumen. This goes on increasing, filling the whole ovule, and reducing the testa to a thin coating.

a. Just before expansion.

b. b. b. Expansion.

c. After expansion.

d. Sometime after expansion.

e. Corolla one-half the length of calyx seen under pressure.

f. Corolla two-thirds of the length of the calyx.

Suddyah : July 2nd, 1836.

PLATE LV.—Q.*

Shows the passage of the boyaux along part of the upper portion of the placenta, and their passage to the ovula.

1. 3. At fecundation.

4. Shortly after fecundation.

5. Long section half-ripe.

6. Commencement of embryo.

7. Nearly ripe.

ARUM *orixense*,—PLATE L.

In this species the nucleus is surrounded by a single tegument to which it adheres firmly, except by its attenuated neck. This neck projects to a short distance beyond the foramen in an early stage: but at the time of dehiscence of the anthers, it is shorter than the neck of the testa; the stigmatic tissue is broad above, attenuate inferiorly, and a communication with the ovule is kept up by a conical process, hollow inside, and there occupied by stigmatic tissue, which hangs down as it were from the apex of the ovary, and reaches to a level with the foramen. At an early period there are traces of the excavation of the nucleus, indicated by the grumous dense tissue, this is especially visible in the neck. At the time of expansion of the spath, this excavation is of con-

* Name omitted in orig., probably an Asclepias.

siderable size; the portion within the neck presenting the same appearance as it did previously, that is, the dislocated tissue has not as yet been absorbed. This nucleus is extremely like a second coat, particularly in its neck, but it is not perforated.

The next stage, sometime after fecundation, presents the foramen closed up; the excavation much increased, extending nearly to the apex of the neck of the nucleus. It has a shining appearance, and is lined by a very distinct membranous (albuminous) embryonary sac, fixed by its apex, but totally free elsewhere, although it reaches to the top of the nucleus. In the earliest stage at which I have seen it, its apex was occupied by a brown grumous mass: it contains likewise a few active molecules of two sizes, large and small. The next stage presents the grumous mass showing obvious traces of cellularity, especially towards its apex: but the lowermost cells are only half-formed, and surrounded with the grumous matter of a more lax nature. The extreme apex is occupied by a globular cell, containing very few granules. This cell is visible up to a late period, and it is to it that the young embryo is attached. The granules soon increase in number; they are larger than the active molecules, which abound in the young albumen. The cells soon become more developed, and will shortly be found to have assumed the form of albumen. When this is half-formed, it is inferiorly either truncate or concave: it swarms with active molecules, which, as indeed in all cases, form that milky fluid which is discharged when a section is immersed in water: the embryonary sac is constricted about its middle, the lower portion being empty, and remaining portion so to a very late period, perhaps always. I should not say empty, because it is occupied by a fluid, but the albumen does not extend into it. At this period the neck of the nucleus is very short, and its substance very thin; the lower portion is still adherent as it always is, to the corresponding portion of the testa. The embryo which is very minute and globular, may be found in its apex, attached to the terminal cell. The embryonary sac in that portion unoccupied by albumen, is still very dis-

tinct: its adhesion is very slight. At a late period the upper portion of the testa is much thinner, and is lined by the nucleus, which is very thin. The corresponding portion of the embryonary sac is occupied by the albumen, which is globular and dense: the lower portion being still unoccupied. The embryo is fully developed, and the lateral slit, and enclosed plumule visible.

a. At anthesin, during fecundation.
b. Apex of outer coat cut away.
c. Rather earlier than the above, but from the same spadix.
d. After fecundation, and fall of upper portion of spadix.
e. Ditto apex slightly magnified.
f. Embryonary sac removed.
g. Some time after fecundation.
h. About the same period, upper part of testa removed.
i. Embryo and apex of albumen.
j. Young embryo $\frac{1}{20}$th.
k. Before expansion of spathe.
l. Seed nearly mature; embryo of ditto, detached.
m. Embryonary sac detached.
n. Long section of embryo.
o. First development of albumen, shortly after fecundation.

Suddyah: July 3*rd*, 1836.

CELTIS,—PLATE LIII.

The ovary must be examined very early, and before the flower is a line long in order to detect the ovule in its first stage. In this it is an oblong cellular grumous body, pendent from near the top of the ovary, but more decidedly related to one stigma than to the two.

In the next stage it will be found to be annuliform about the middle, or this part will be found thickened into a sort of margin.

In the next, (but which takes place sometime after the nucleus is nearly concealed by the coat that has grown up

from the ring, and the base of this again has become surrounded by another coat which will form the testa) the ovule commenced to turn on its axis.

At the time of flowering, the ovule will be completely curved, so that its foramen will be approached to the hilum; the outer coat is thin; the inner projects beyond this in a cellular loose neck; the nucleus is quite enclosed. Subsequent changes as usual. The embryonary sac I have only seen when well developed, at this period it is attached by both ends, but I believe its real apex is at the base of the ovulum, i. e. it is developed downwards. The testa is thin, no trace of a secundine except its apex, which still projects, looking like a small fungous mass, no embryo visible.

The endocarp now becomes osseous, and separates almost from the fleshy covering, the embryonary sac commences to be filled with albumen, and pushes back the nucleus until this is reduced to a thin coat. The embryo is well developed.

At maturity, the most obvious coat is the nucleary; the secundine has gone; the testa except about its base appears to adhere to inside of drupe; the embryonary sac is incorporated with the albumen; no vessels exist.

1. Ovulum in a very early state. Bud not one line in length.
2. Ditto more advanced, the annulus shewing the rudiment of the second coat to be visible.
3. Ditto more advanced.
4. Same in sitû, stigmatic tissue not visible.
5. Ditto more advanced, half inverted, the greater cellularity of the apex of the secundine shown, proving that it must be formed first?
6. Ovule about the same period.
7. Ditto more advanced.
8. Ditto more advanced.
9. Ditto ditto inner coat now nearly enclosed.
10. Ditto perfectly formed.

10 *a*. Same in sitû, stigmatic sphacelation, sphacelation greater along the base of ciliary processes, (no pollen visible or stigmatic.)

11. Ovule after fecundation ?

11 *a*. Same long section; *a*. testa; *b*. apex of inner coat, the only part I can detect; *c*. nucleus; *d*. embryonary sac.

11 *b*. Embryonary sac separated, it still remains attached to apex of nucleus.

12. Ovary more advanced; *a*. drupaceous coat originating from endocarp; *b*. seed.

12 *a*. Longitudinal section of ovule. Same letters have the same references as No. 11.

13. Mature fruit, pulp of a purplish colour; *a*. drupaceous coat; *b*. nucleary coat; *c*. embryonary sac, albumen of; *d*. embryo, the inner coat is not distinguishable, the outer I believe adheres to the drupe, except at its base, the hardness of the drupaceous portion renders the examination of the fruit, so far as the coats of the seed are concerned, a matter of some difficulty.

Burral River: June 15*th*, 1838.

Scepaceæ,—Plate. liv.

The pericarpial leaves appear to be situated right and left. The stigmata are four, more or less distinct, or more or less combined in pairs, and when this is the case the union takes place between two belonging to different carpella. Hence the compound stigmata will be anterior and posterior. I look upon this as a proof that the stigma of a carpellary leaf is never a single organ, moreover, that it is a double organ, each originating from the carrying up as it were of the lax involute margins of the leaf. There is no indication of any consequence that the fruit is formed on a quarternary plan. Again, the union of the stigmata of different carpella goes far to prove that such occurs in all the instances of stigmata opposed to the placentæ.

Along the axis of the septum a broad line of vessels run. The ovula are pendulous from the top of each cell: they are funiculate (funiculo-brevi crasso) the coats are very distinct, as well as their openings; and these are directed outwards and upwards. At an early period they are overlapped by a somewhat tongue-shaped cellular production from the placenta, which completely covers over the foramen. The ovula are in addition more or less immersed in rigid simple hairs, most of which appear to arise from the base of each cell.

In their development they agree with other instances.

The raphe often displaced, is always however next the axis, at the chalaza it becomes ramified over the outer surface of the seed. The ramifications proceeding upwards towards the foramen.

1. Female flower: viewed parallel to each carpellum.
2. Ditto, viewed laterally.
3. Longest section of ovary, parallel to a carpellum.
4. Ditto placental, plates reflexed to show the situation of the foramen.
5. Ovulum viewed externally } with placental plates.
6. Ditto internal face } with placental plates.
7. Ditto front view, placental plate reflexed.
8. Ditto longest section through testa.
9. Ditto through both coats.
10. Apex of young fruit, with abortive and fecundated ovulum.
11. Longest section of young ovule after fecundation; *a.* testa; *b.* inner tegumen; *c.* nucleus; *d.* its excavation.
12. More advanced, with barren ovulum; *a.* testa; *b.* inner teg.; *c.* nucleus; *d.* embryonary sac; *e.* its excavation; *f.* portion of raphe.
13. More advanced, section parallel to true faces of seed, the others are alternate; *a. b. c. d.* have same references; *e.* embryo; *f.* chalaza.
14. Section of testa, to show the disposition of its raphe and chalaza.
15. Nearly mature fruit, front view.

16. Ditto lateral.
17. Ditto laid open along the back of a carpellum; seed removed, its plate and the abortive ovulum remaining.
18. Similar one viewed laterally, seed somewhat reflexed.
19. Outer view of seed.
20. Ditto inner; *a*. raphe.
21. Long section of nearly ripe seed; *a*. testa which is baccate; *b*. tegmen now somewhat cartilaginous; *c*. nucleary membrane; *d*. albumen developed in embryonary sac; *e*. embryo; *f*. raphe; *g*. belongs to the second integument which is thick at the base.
22. Embryo.
23. Ditto, one cotyledon with its half of the radicle.

The process of the placenta never enlarges, it is merely developed to assist in fecundation, and I will venture to say, that if a species be found with the foramen directed inwards towards the placenta, that it will not exist. It is present before fecundation. It must be borne in mind, that a process of the placenta connected with fecundation is totally different from any process subsequently becoming arillus. And particularly so in the present instance, because if the production were merely an excess of growth and arilloid, it would originate from the funicle. Dr. Lindley has not borne this in mind, and reasoning on the idea that it subsequently forms the arillus, he states that it does not cover the foramen before impregnation. This process is to be found in the ripe seed, with which, however, it does not separate.

The albumen is as usual developed in the embryonary sac, which is pendulous, but establishes a communication by approximation with the chalaza.

The cotyledons are always parallel with the true faces of the seed.

Dr. Lindley says it is at once obvious that these albuminous seeds, and dehiscent four-valved, four-ovulate fruits, cannot be combined with Amentales. But although the structure of the males is so decidedly amentaceous, the habit is not so, and

this, with the nature of the females, incline me to think that the nearest affinity is with Stilagineæ.*

In such view it will be the connecting link between this order and Cupuliferæ. If Wallich's Gymnobotrys belongs to this place, an additional point of resemblance is presented with Euphorbiaceæ by *milky juice*. With regard to Lindley's distinctive characters of Scepa, and Lepidostachys, the number of stamina is perhaps the most to be depended on, for my plant has certainly a placentary plate to each ovule, although there are only two stigmata, and in addition the ends of the ovula are immersed in hair.

I have not yet seen the perfectly mature fruit.

All the integuments adhere somewhat together: the outer, Lindley's arillus, is baccate testa; the tegmen or inner membrane, is Roxburgh's parchment-like middle membrane; the inner membranaceous coat results from the remains of the nucleus; the embryonary sac is identified with the albumen.

Roxburgh's description of the seed is correct, and although it would be difficult to ascertain what a Botanist of the old school would mean by an arillus, I see nothing that should induce a firstrate Botanist to call the fleshy coat of this genus an arillus, unless it be the mention of three coats, a fact by no means incompatible with the testoid nature of the outermost.

NELUMBIUM.

On certain points of structure in Nelumbium.

The leaves of this plant are very remarkable for having the stomata confined exclusively to the callous-looking oval disc that exists in the centre of the upper surface of the limb, and which is opposite to the petiole. The remainder of the vast limb, throughout which the green matter is deposited, is

* The wood should be examined.

merely minutely papillose on the upper surface. The nervules pass from the apex of the petiole in a radiating manner. On either side of each is a narrow canal containing air, which communicates directly with those situated under the callous disc, and through these with the stomata. There is likewise free communication between the above, and the air cavities of the petiole.

The space under the disc is divided into a number of irregular cavities communicating with one another, and on their parietes *globuline* is found. The cavities on either side of the nervules appear to have no communication whatever with the parenchyma of the leaf. This structure is hence remarkable for the curious site of the stomata, and for isolation of the green parenchyma from the organs of aëration. The stomata are evidently open. *See pl.* 56, *E. figs.* 3, 4, 5, 6, 7.

The pollen consists of two very distinct membranes, the outer is of a pale, lemon, yellowish-brown colour, thick, not extensible, and marked with three longitudinal lines: with variously shaped depressions. *See pl.* 56, *E. fig.* 9.

Are these the boundaries of cells, or are they rather glands filled with oil? globules, which are of a lemon colour, separate on pressure.

The inner is colourless, highly extensible, containing very minute granules. Immersed in water, the outer coat bursts suddenly along one of the longitudinal lines, and expels the inner membrane without altering its shape. To a portion of the circumference of this, lax cellular substance adheres, which perhaps indicates its attachment to the external membrane. Dehiscence from stigmatic influence is much more gradual; the inner membrane being elongated, and at first presenting an hour-glass shape. The upper end of this is covered by the outer membrane. *See pl.* 56, *E. figs.* 2 *and* 8.

The ovula are always solitary and pendulous. During their development no change in situation occurs, and contrary to a very general law, the openings of the coats are always turned away from the stigmatic canal. This is open

and free, and evidently presents the nearest route for the passage of the boyaux. *Pl.* 56, *A. figs.* 1, 2, 3, *also pl.* 55, *L. figs.* 1, 2. Long before expansion.

At a very early stage they are reduced to primine and secundine : the orifices of both which are on a level.

The nucleus is a *subsequent ?* development, and arises from the base of the cavity of the secundine. *See pl.* 56, *B. fig.* 4. It soon presents traces of an internal cavity.

Just before expansion the coats of the ovule have become narrowed towards their openings. These are very distinct. that of the secundine projecting beyond that of the primine. The nucleus being entirely included : it is at this period an empty sac. *See pl.* 56, *C. figs.* 1, 2, 3.

Very probably this is erroneous : in all others the nucleus is co-existent : if this be so here, the primine is reduced to a mere rim. *See pl.* 55. *L. fig.* 2. *c.*

All the ovula of one torus have not the same development, the secundine being in some shorter than the primine.

After expansion, but previously to impregnation, the apex of the primine has become elongated, and is now nearly on a level with that of the secundine. The nucleus still remains an empty sac.

During impregnation, the mouth of the primine has contracted, that of the secundine being but very little exserted. *Pl.* 56, *F. fig.* 1. *a.*

The apex of the nucleus becomes of a brownish colour.

Shortly after impregnation, a central cavity is visible in the nucleus, the parieties of the sac or cavity being most distinct towards the apex of the nucleus, becomes more and more indistinct towards the base. *See pl.* 56, *A.* [when is this cavity first visible ; Re-examine again the first appearance of the vitellus.] At the apex of this a vesicle is visible, attached to the apex of the nucleary cavity by one of a much smaller size. This is the first rudiment of a quartine. As the development proceeds, the quartine enlarges, becomes cellular, and extends downwards, pushing before it the substance of

the tercine. The embryo is now visible, lodged in a concavity at the apex of the quartine, but free from all adherence, and consequently very easily detached. The nucleus is at this time narrowed towards the middle; a corresponding dilatation having taken place at its base. *See pl.* 55, *G. fig.* 3.

As the quartine proceeds enlarging, it pushes backwards the nucleus more and more, until the basilar dilatation contains it entirely, with the exception of its thin parietes which remain in opposition to those of the secundine; the base of the quartine is now narrowed into an oval-shaped cellular process, which extends gradually through the substance of the nucleus, and subsequently forms a communication with the chalaza. *See pl.* 55, *G. figs.* 1, 2, *also pl.* 55, *H. figs.* 2, 5.

This communication is difficult to trace, the surrounding tercine being grumous. The cells contiguous to the communicating process likewise assume a longitudinal direction.

This coat is entirely cellular, as well as its *chalazar* communication: the cells of the body being rounded, and those of the communicating process variously elongated; the embryo soon loses its globular form, (*Pl.* 55, *H. fig.* 3,) and assumes the appearance represented in *pl.* 55, *G. fig.* 4.

It is not enclosed in the quartine, but is merely lodged in its apicular niche.

It is perfectly homogeneous: being composed of small cells, containing grumous matter. *Pl.* 55, *H. fig.* 3., *G.* 4.

The apex of the embryo, or that which subsequently becomes the radicle is the first to assume a definite form, G. 4, in which the rounded extremity is the rudiment of the future radicle. The opening of the primine becomes more and more contracted, and finally encloses that of the secundine.

My notes go no further. The subsequent development I imagine to be as follows: the cotyledons are secondarily developed, and pass down outside the membrane of the quartine. They are rapidly developed, nearly reaching to the chalaza before the plumula has assumed a definite appearance. *Pl.* 55, *K. figs.* 1, 2.

When the seed is two-thirds developed, the cotyledons may be said to be perfected, they are thick-fleshy, with several vascular fascicles, and concave in the upper half, corresponding to the convexity of the sac of the quartine: the plumula is at this period considerably advanced, but occupies a comparatively small portion of the sac of the quartine. The exostome or micropyle is very distinct, still preserving its original situation with respect to the stigmatic canal. The apices of the cotyledons are, as it were, constricted; this portion, as well as the corresponding portion of the integuments being distinctly sub-sphacelated. *See pl.* 56, *D.* 1.

The mature fruit is, as well as the immature ovule, almost entirely enclosed in the cavities of the torus, with which however, it is only united by its base. Towards its apex, and on the side it is marked with a callous spot, which is invariably opposite to the side to which the exostome points. The teguments are cellular-spongy, the micropyle occupying its original situation, and perfectly distinct. Along the side with respect to the axis of the plant, and as usual, next the placenta, three vascular bundles, forming the raphe, run, which terminate in the chalaza: the tissue of which, as well as of the corresponding apices of the cotyledons, are, as I have said above, sub-sphacelated.

Not much change has taken place in the cotyledons. The radicle is scarcely distinguishable. The plumule is immense: occupying the greater part of the cavity of the quartine, vitellus, or sac of the amnios. The cauliculus is very distinct, the leaflets of the plumule are unequal, that *next the axis?* being much the larger. The air cavities of the petiole of this are very distinct, as well as the septa: the communicating clefts of these, are, as I have shown in Eriocauloneæ, visible. The vernation is involute.

The sac of the amnios is excessively fine, and filled with a limpid gelatinous fluid.

[Points to be determined,—site of caruncule, and its corresponding air cavity in the parietes of the carpellum. Site of exostome, as to the axis; ditto to the nucleus, visible in its earliest stage, and whether it is cellular or excavated prior to the appearance of the vitellus.

Relations of the teguments of the seed with those of ovulum.

Development of cotyledons.

Relative site of large plumulary leaf.]

Impregnation in Nelumbium.

I have already remarked, that no change whatever takes place in the situation or direction of the ovule from its earlier periods, to its mature state. It is a general rule that the openings of the coats of the ovula are presented directly, or by the shortest route to the influence of impregnation; very marked examples of this law occur in Plumbagineæ, Castineæ, &c. and in Leguminosæ, in which the openings are always uppermost, for the knowledge of which I am indebted to Dr. Brown. The present anomaly is caused, I imagine, by the shortness or thickness of the funicle which obviates all change about the period of fecundation. The stigma is large, and highly papillose: its canal communicating with the interior of the carpellum is very distinct, and likewise papillose, the papillæ gradually diminishing as we proceed downwards. They are prolonged down *on the funicle,* but terminate on a level with the exostomium, rather to the base of the funicle. On the opposite side they terminate on a level with the apex of the ovarium. *Pl.* 56, *fig. F.* 1.

The stigmatic surface will be found covered with pollen, the boyaux of which have entered the canal, the outer membrane enveloping the upper portions of these prolongations. The stigmatic canal is filled likewise with a mucilaginous tissue which passes among the papillæ. *(Pl.* 56, *fig. M.* 1, *b.)* On the side next the ovulum it is reflected over the whole of the funicle. It terminates in a cap or hollow blunt cone-shaped prolongation, *(Pl.* 56. *M.* 3,*)* which passes off to, and appears to embrace the exostome. *Pl.* 56, *F. fig.* 2, 3. The termination of the canal is bounded by a transparent membrane containing some granules, which passes over the papillæ. *(See pl.* 56, *fig. M.* 1, *b; and pl.* 56, *F.* 2, 3. *a. a.)* The circumferential tissue of the funicle is yellowish, and mucilaginous.

The boyaux pass down, imbedded in the lax tissue of the stigmatic canal. They terminate at various points: a very few, and often only one, reaching the funicle, to which they appear to be guided by the conducting tissue. They are here turned from their original course, passing off round the funicle, towards the cap-shaped process.

Along this they descend in a generally tortuous manner, and one or two become engaged in the exostome within which they pass; tracing them (or it, as the case may be) further, we find them engaged in, and passing along the bottle-shaped neck of the secundine, until they reach the nucleus, to the loose cellular apex of which they become applied apparently rather firmly.* Beyond this I have ascertained nothing.

The boyaux terminate in a cul de sac, at least I have not been able to ascertain the existence of any opening. *Pl.* 56, *fig. M.* 3. *c.* I have never traced more than two into the opening of one ovule. In one case the tube was branched, both terminations having reached the nucleus. *Pl.* 56, *fig. M.* 2, 3. I observed no circulation either in the grains of pollen or in their tubes.

The tubes appear occasionally to be broken up, if I may so express it, before they reach the cap, or reflected *funicular* portion of the conducting membrane. This, when such is the case, appears to contain, or rather to be scattered over with grumous granular matter, which still passes off to, and appears to penetrate the apex of the secundine, and has precisely the appearance of the fovilla of pollen, when this has burst by the action of water. *See pl.* 56, *fig. M.* 4. *c.* The absence, or disappearance of the tubes is very curious, particularly as impregnation still takes place effectually. I may observe, that while examining these ovula during the rains, I only in one instance traced the tubes to the ovula. In every other, and I examined some hundreds, nothing of the sort was

* I have traced them so far in a Crotalaria, in which they end in cul de sacs, which are applied to the apex of the nucleus. In one instance two new and smaller tubes or cells had become applied to the original end of the boyaux!! Both these cells contained granules.

observable, the boyaux did not even reach to the end of the stigmatic canal. Still impregnation was almost universal.*

On the setting in of the fine weather, I recommenced my observations which had been interrupted on account of the above circumstance. I have since examined many ovula at different periods, and I have found the penetration of the boyaux into the ovula very general. The examinations took place with the same means, and give rise to doubts as to the universal necessity of the final penetration of the pollen tubes.

NELUMBIUM,—DESCRIPTION OF PLATES LV. LVI.

The nucleus is visible at a very early period, when the flower bud is half developed it has a central cavity ! ! ! or excavation.

Pl. 55, 1., Represents the nucleus of an ovule : into the secundine of which a membrane had been introduced in all probability in continuation of the cap. This membranous prolongation was excessively fine, and separated with the secundine, the mouth of which seemed to embrace it firmly : a central cavity is evident, the parietes of which are distinct towards the apex, more and more indistinct as we approach the base : the embryo is visible in the shape of a circular vesicle attached by a much smaller one to the apex of the nucleary cavity : the apex of the nucleus is minutely papillose, or rather laxly cellular.

The membrane passes down the secundine at least as far as the apex of the nucleus : it is applied to the wall of the secundine. It varies in size, sometimes closely resembling a boyau, at others being much finer than these elongations. It passes down, and is applied to the apex of the nucleus to

* I have noticed the same in a Periploceus genus, although in some, final penetration had occurred, in others the tubes had not reached the placenta or even emitted their contents. Yet in these, sections of the placenta immersed in water, gave out abundance of mobile granules similar to those contained in the tubes. At the same time the ovula were evidently fecundated.

which it adheres rather firmly. It is sometimes branched, and terminates in a cul de sac which is occupied by a number of granules. It is not a continuation of the cap : although the latter separates with it : yet the boyau, for such I believe it to be, may be traced upwards beyond the extent of the cap and both the terminations had passed into the ovulum. *See fig.* 2. *b*.

Pl. 56. A. Ovules at a very early stage.

1. Long section of ovarium and ovule, $\frac{1}{5}$ inch focal dist.
2. The same detached, $\frac{1}{35}$ focal dist.
3. Section of ovule, nucleus not yet visible, $\frac{1}{10}$ focal dist.

B *a*. Fruit.

b. Seed with testa.
c. Ditto shewing the raphe.
d. Testa removed.
e. Separated along the cotyledons.
f. Long section of seed and fruit.
g. Plumula.
h. Raphe.
i. Chalaza.

C. Ovula just before the expansion of the flower.

1. Section of primine : secundine entire.
2. Ditto of primine and secundine, nucleus entire.
3. Nucleus, primine and secundine cut away.

D. Sections of ovula, perhaps two-thirds developed, after impregnation.

1. Longitudinal.
a. Pericarp.
g. *Caruncula*.
b. Foramen ; *f*. hilum.
c. Testa.
e. Amnios.
d. Plumula.
2. Transverse.
a. Amnios.
b. Part of Plumula.
c. Vessels of cotyledons.
d. Cotyledons.

E. 4. 5. Pollen seen by two faces.

1. Ditto burst.

3. 6. 7. Ditto.

2. Pollen tube shortly after.

8. Ditto sometime after.

9. Outer membrane of pollen.

F. During impregnation.

Pl. 55. G. 1. Long section of ovulum after impregnation; stigma sphacelated.

2. Vitellus and part of the tercine pushed before it.

3. Long section of ovulum, somewhat earlier.

4. Embryo of No. 1.

5. Base of the vitellus.

6. Cells towards its apex.

H. 1. Long partial section of secundine and vitellus, shewing the embryo to be external to that sac.

2. Long section shewing the communication between the vitellus and chalaza.

3. Embryo.

4. Chalaza.

5. Vitellus and its process separated.

K. 1. Long section of ovule considerably advanced; no division of the cotyledons is seen as they are applied face to face.

2. Cotyledons and embryo separated, the sac of the vitellus remaining enclosed between the crura of the cotyledons.

Fig. L. 1. Ovule and ovarium at a very early period.

2. Do. separate; *a.* nucleus; *b.* secundine; *c.* primine.

3. Apex of the secundine, two pollen tubes have entered.

4. Do. the hollow conical-shaped process, including one tube which appears about to enter the foramen.

Pl. 56. M. 1. Represents longitudinal section of the ovule, part of the ovary and stigmatic canal. The side of the canal, from which the papillæ arise, as well as that in communication with the cap, are of a yellowish colour, and mucilaginous appearance. One side of the stigmatic tissue, that next the ovule, is carried lower down than the opposite one. The ter-

mination of the canal is blocked up by a mucilaginous looking membrane, quite identical in appearance with that of the cap, with which it is no doubt continuous. A tube is seen passing down along the cap in a tortuous manner, and to engage itself in the secundinal opening.

a. Mucilaginous yellowish tissue.

b. Stigmatic canal and papillæ.

c. Transparent membrane closing the end of the canal;

d. The cap.

e. The tube; *f.* primine; *g.* secundine: transparent except at its apex; *h.* its apex; *i.* raphe; *k.* chalaza; *l.* two boyaux passing down the canal, the upper one, passes round the funiculus above the under one, which takes the edge of the membrane as its guide.

M. 2. An ovule with its funiculus, which is of a yellowish colour.

a. Opening of the primine.

b. Ditto secundine.

c. Cap.

M. 3., *a.* Part of the cap with the adjoining tissue; *b.* two tubes running very tortuously, and both entering the foramen of the secundine.

c. Apex of the secundine separated from the base.

In certain instances the tubes reached the ovula, in others they were not to be traced even into the* ovary. Yet these sections of the placenta, when immersed in water, gave out abundance of mobile granules, altogether similar to those contained in the boyaux. These facts are inexplicable, for it cannot well be supposed, that things easily appreciable at one time, should elude the observer at another, particularly when examined under the same circumstances and with the same means. They rather give rise to doubts as to the universal necessity of the penetration of the pollen tubes to the ovula.

Mergui: September 3rd, 1834.

* MS. here injured.

ARTABOTRYS,—PLATE LVII. A.

Ovule of Artabotrys odoratissimus, Anonaceæ, Demonstrating the origin of the plates which divide the albumen.

1. Ovule.
2. Ditto long section; through its greatest diameter.
3. Nucleus detached; a portion of the secundine adhering to it.
4. Transverse section of ovulum; *a.* primine; *b.* secundine; *c.* nucleus. Two vascular cords are seen on this section; at *e. d.* tissue containing air surrounding the two processes in the centre of which the vascular bundles run; *f.* cavity of the nucleus.
5. Portion of transverse section; *a.* testa or primine; *b.* secundine separated; *c.* nucleus.
6. Transverse section of ovule more advanced; *a.* testa; *b.* secundine; *b. a.* commencement of its prolongations; *c.* nucleus.
7. More advanced ovule, section made along its least diameter; *a.* testa; *b.* secundine, each prolongation shewn to be double; *c.* nucleus.
8. Long partial section of less advanced ovule along its greater diameter; *a.* testa; *b.* secundine; *c.* exostome; *d.* nucleus; *e.* raphe.

In this ovulum the primine and secundine always cohere; at least in their earliest stages; the 2nd *raphe* does not reach to the base of the secundine.

ALLANTODIA,—PLATE LVII. C.

1. No vessels are to be distinguished. Sections of fertile pinnæ.

PHARNACEUM,—PLATE LVII. B.

1. Ovule at a very early period, the primine secundine, and nucleus are very apparent.
2. Ovule more advanced; the primine *a.* has enclosed the secundine. The funicle is attached to the ovule throughout its whole length.
3. Rather more advanced; a slight lobule is visible at the apex of the funicle.
4. Primine considerably enlarged and narrowed at its apex, which embraces the apex of nucleus. The elongation of the funicle commenced.
5. Elongation still more advanced. This figure shews the situation of the ovule, while attached to the placenta; *a.* margin *next the base* of the pericarp.
6. More advanced ovule; the funicle has commenced to enlarge at its base.
7. The funicle has now reached a considerable length, and the central dark line is now visible. This line appears late, perhaps not before impregnation?
8. Ovule completely developed, but not indurated. The funicle has become enlarged below the hilum into a a sac, through which the central fascicle passes.
9. Longitudinal section of the sac; process of the funicle remaining attached.
10. Mature ovulum.

December, 1833.

PLATE LVII. D.

[*Hydrocharis morsus.* The stomata rare. They exist as here represented.

The hollow lobes of the receptacle are filled with the same fibres. Their walls seem to be composed of 2 layers, of which the inner is the most lax.]

Plate lvii. F.

Barclaya, Nympæaceæ.

1. Long section of a flower.
2. Anther.
3. Ditto cells very small.
4. Ditto cells aborted.
5. Ovulum before expansion.
6. Ditto after expansion.
7. Ditto testa removed.

Mergui: Oct. 25th, 1834.

[I doubt much the fact of the non-existence of vessels in submerged plants: if the parts of these, that are at some period or other elevated above water, have vessels, whence do they originate? As for successive imbibition it takes place just as well in vascular, as evascular plants. If we allow the function of ducts, I do not see why we should deny the existence of spiral vessels. Where is the difference, since they are modifications of one and the same structure? I doubt also the stated evascularity of the mistletoe.

Mergui: November, 1834.]

Plate lvii. E.

Raphides in ovaria.

On the raphides found in the ovaria of various species of Fuchsia.

While examining the ovarium of the *Fuchsia conica* and its ovula, most of which are sessile while some are furnished with a funiculus of considerable length, I was struck with the appearance of granules or rather oblong bodies in one of the funicules, some of which had nearly reached the hilum. Pl. 57, E. Fig 1. My first impression was that I had dis-

covered the grand secret of the vivification of the ovulum, and that these in fact were the spermatic granules proceeding to their destination. But I was immediately convinced that they were by far too large for these granules, and on perceiving, vast quantities of small raphides floating about in the water in which the object was placed, my second impression was that they were fascicles of raphides. The truth of this impression, was soon proved on dissecting one of the funicula, I soon detached the apparent granules, which separated into a number of raphides on reaching the water. These raphides differ in no respect from the ordinary form; they are fasciculated, as I believe they always are, but appear to be rather smaller than is usually the case. Their discovery in such an unusual situation induced me to examine them more closely. On inspecting the more advanced ovula, I saw that their interior was partly occupied by these fascicles, which seemed more plentiful towards the apex of the ovulum. I also found that in the long fimbriated ovula, when the form of the nucleus or tegmen was sufficiently defined, that they were no longer to be found in the funiculus, and that they had reached their destination, I suppose by passing through the foramen, which is situated near the hilum. On making a longitudinal section of an ovulum at the same stage of advancement, I found that the central and larger mass was homogeneous, the surface of the section being scattered over with detached raphides. On making a longitudinal double section of the ovarium, I thought I perceived a fascicle or two proceeding down the lesser conductor, occupying the central part of the style, many could be seen passing up to the two glandular bodies attached to the calyx. Very few were present in the placentary tissue, most of the ovula were filled with them, and at the exsertion of the funiculus in one or two cases, facicles were crowded as if trying for admittance. I observed one abortive ovulum, and what is very remarkable, this had only one or two fascicles about midway. I am of opinion, that on examining a much younger placenta, the fascicles will be found exclusively in it and inclined to the direction of each ovulum. On examining an ovarium in which the car-

pella were beginning to be filled up with cellular tissue, and in which most of the ovula had aborted ? modifications were presented. The barren ovula abounded in raphides, situated in the central mucous undeveloped mass. In the fertile ovula they seemed exclusively attached to the *testa,* none were present in the nucleus or in the embryonary sac, and those present, attached to the testa, were exceedingly reduced in number; they were present in all the ovula I examined, not restricted as might be supposed to those of one ovarium, but present in those of different ovaria. Their subsequent diminution of number in the more advanced ovulum, would indicate their absorption or conversion into the substance of the ovulum. Can they be interested in any chemical change taking place during the early development of the ovulum ?

In the ovarium of the F. gracilis, not more than a line and a half long, they do not appear to have entered the ovula : these are filled with air, which is easily squeezed out through the foramen existing near the hilum : they abound in the placental mass; some fascicles are visible at the base of the funiculi : between the walls of the ovarium, the external coat of which already presents a defined appearance, and an internal green semi-organised mucilaginous mass, they occur in vast quantities, they likewise occur, but not so numerously in the peduncles.

1. and 2. Ovula in a very early stage of development, but after impregnation, in which the fascicles of raphides are confined to the umbilical cords; some have nearly reached the hilum.
3. Farther advanced ovulum, in which the raphides are no longer found in the cord, but have entered the ovulum.
4. Longitudinal section of ditto. The raphides are seen lying in the unorganised mass of the nucleus ?
5. Some more magnified, representing the surface of the section the raphides occurring separately from the effects of the section.
6. Barren ovulum.

October, 1831.

DEVELOPMENT OF LEAVES, PITCHERS, STIPULES AND TENDRILS,—PLATES LVIII. TO LX.

Pl. 59. A. *Bauhinia.*

1. Very young leaf. Lateral view.
2. Front view.
3. Apex of growing point ; *a. a.* stipules or scale buds—one deflexed ; *b.* the leaf of the same ; *c.* first puncta of other stipules ; *d.* disc. This *bears on very oblique Pistilla !**

Pl. 59. B. *Bursera (Boswellia) serrata.*

1. Vertical view of apex of axis, shewing the three puncta, of which two are very small.
2. The same, with very young leaves not removed, seen vertically.
3. Ditto lateral.
4. Very young leaf $\frac{1}{10}$. Front view.
5. Same more developed lateral ; the undulating prominences on the further pinnulæ.
6. Same more advanced seen in front.
7. Transverse section of same.
8. Oblique lateral view of leaf more advanced.

An instance shewing that the point of the leaf may be quite simple at first, and yet subsequently become foliaceous. It shews also that the pinnation is determined by the develop-

* [Among other circumstances to be carried in mind in the examination of the style with reference to ascertaining the composition of the ovarium, the number of angles and sinuses presented by the canal of the style, is by no means to be neglected. For in many, perhaps most instances, the convolution of the carpellary leaves is not confined to the lamina or the ovary, but is continued to a greater or less? extent up the style in which the entrant angles will always tell the number of septæ or placentæ, the spaces between them and the number of cells.

On stigmatic surfaces not terminating the style, and so destroying that definition which states "the stigma is the upper extremity of the style." I may cite as instances, Apocyneæ, Asclepiadeæ, and in a very marked degree Nymphea, and still more the aphalangial forms of Pandanus, in which the stigmata are papillose lines on the posterior side of the spinous prolonged subulate styles.

The single vascular fascicle, one to each division or costa of ovarium, is in accordance with a tricarpellary structure, but not with a hexacarpellary ; the placental vessels rarely if ever being single.

In the six carpelli hypothesis, the barren carpella have as large vessels as in fertile.]

ment of the cellular tissue alone, even up to eight; there are no vessels but one in the midrib.

Pl. 59. C. *Aralia sciodaphyllum.*

1. Bud just protruding from a nearly complete vagina. Lateral view.
2. The next leaf ventral face.
3. The next lateral.
4. The next lateral.
5. The next ventral.
6. Ditto laterally; one stipular production removed to shew the next leaf No. 7.
7. Last leaf, i. e. with a limb and its stipular productions; *a*. punctum of another leaf.

This shews digitation to be a degree only of pinnation, with the foot stalks umbelled inserted.

It shews likewise that as the terminal pinna is the earliest developed, so it continues the largest.

And the stipulæ very early developed are not independent of the petiole.

Shews that the division into pinnulæ is primary, as in Boswellia or Bursera.

Pl. 59. D. *Poinciana regia.*

1. Apex of branch, with two very young leaves and the discal point. The larger leaf furrowed along the middle with rounded edges; but no prominence.
2. Represents the same more developed; each prominence will become a pinna, then a bipinna.
3. Same more developed, each pinna is now undergoing the same change that the larger leaf of No. 1, is represented as doing.
4. Same more developed, each has now assumed the form of No. 2, and each prominence will be a pinnule.

Results.

One result of this is that the ordinary entire leaf, is the simplest form, particularly when combined with only one

vein; it is simplest because though mature, it is organised, as all leaves are at an early period.

That there is no distinction between a simple, digitate, pinnate, bipinnate leaf, except a degree of division.

That the division depends upon the species, that it is independent of any veins.

And hence all hypothetical ideas, that make the divisions of the leaves dependent *on want of parenchyma between the veins,* is erroneous. Rather the degree of length of the veins depends upon the form of the parenchyma.

That as all leaves are simple *ab initio,* and the degree of composition being dependent on ulterior development, decompound, or more than tripinnate leaves are the most advanced. Hence the leaves should be taken into consideration in reference to the most perfect forms.

Thus Bauhinia in leaf is the simplest perhaps of its section, those Bauhiniæ with emarginate leaves are simpler in this respect than those with bilobed, and these again than those with almost geminate leaves.

It may not be amiss to observe that the form of leaf in Bauhiniæ in its early stages bears upon the subject of obliquity of the style of the pistillum. A lamina well rounded off superiorly, will give an oblique style; and if the rounding off is carried so far that the narrowed part of the lamina is at its base, we may have the ovarium of Boragineæ or Labiatæ, at least in degree of obliquity.*

A pinnated leaf is nothing but an entire leaf with the parenchyma interrupted as far as the midrib.

This is shewn by development, the pinnules in the young state look like ovules in their young state, excrescences from the margins of the leaves; their development is from below upwards; the lowermost being largish, while the uppermost are mere undulations.

See Pl. 60. B. 8. *Boswellia serrata.*

Those pinnules first developed, often so, continue foremost, and become the largest.

* See note p. 221.

A digitate leaf is nothing but a pinnate leaf with the leaflets umbelled inserted, instead of along the petiole. In the young state it is not distinguishable from an ordinary pinnated leaf, such as that of Boswellia, with this exception that the terminal leaflet is the first developed, and is the largest afterwards.

See Aralia digitata.

A Bauhinia leaf is not distinguishable from an ordinary leaf in its young state, it is then chiefly remarkable for the lamina on either side being contracted at the base.

It is in the young state not actually distinguishable from the very young state of the leaves of Inga bigemina, which consist of three points, of which the centre is much the largest, the lateral approached to its base.

A bipinnate leaf is nothing but a repetition of a pinnate, it is in fact at first pinnate and primarily simple, then along each side of the central furrow, an elevated rim, or border appears, then this becomes divided into a number of points.

These points growing to a certain extent, then present the furrow, and the rounded margins or elevated rim, then again points of the future pinnules.

So that nothing can be more obvious than that the bipinnation is a result of ulterior development.

Amphilophium mutisii is proved by development to have a pinnate leaf, of which the two lowermost pinnæ become foliaceous.

The matured form of a pinnated leaf is pari-pinnatum, in which case the point of the petiole, the part first formed remains the same, and in accordance with the direction of development, ceases to produce a lamina.

In the impari-pinnate leaf, the point first formed and last laminiferous becomes completely changed, the sides spreading out into leafy expansions, and the midrib becoming as in the other veins. This appears to me remarkable, there is not even an apiculus or mucro to point out the original entire elamelliferous punctum ! !

HYMENÆA VERRUCOSA AND NANDINA DOMESTICA,—PLATE LX.

Hymenæa verrucosa.—Pl. 60. VI.

1. Bud; stipules removed.
2. The same; the leaf removed, shews trilobed leaf of the smaller stipule, and a lobed oblique disc; the lateral lobes obsolete, and to be in future the stipulæ of the leaf punctum; *a.* stipule.
3. Bud.
3. Same; stipulæ removed.
3*a*. Same; the leaf removed; *a.* axil of bud.
3*b*. Same; one stipule smaller removed; the young leaf of the stipule, the ultimate leaf punctum, and its two stipular rudiments are shewn; *a.* stipûle; *b.* juga, *c.* petiole.
4. Same stipule removed; *a.* juga; *b.* stipule; *c.* leaf.
5. Same in front.
6. Another of about the same period, one stipule removed; same parts seen; *a.* oblique line of insertion of stipule; *b.* future stipule; *c.* future leaf.
7. Ultimate leaf punctum, and its auriculæ to be the stipulæ; *a.* stipule; *b.* leaf.

Wants re-examination.

Nandina domestica.—Pl. 60. VII.

1. Young leaf.
2. The penultimate leaf enclosed in the bosom of stipulæ of the preceding; lateral view; *a.* disc.
3. The same in front; *a.* disc.
4. Leaf, etc. more advanced; shews the scar of next lower leaf and its dorsal scale and bud, over this the lamina of the stipulæ; *a.* bud; *b.* scale of bud.
5. The leaf enclosed in the above: one of its stipulæ removed, the antipenultimate leaf, its stipulæ, and penultimate leaf are also shewn; *a.* stipule; *b.* stipule; *c.* stipule, penultimate leaf; *d.* stipule scar.

6. The same in situ; *a.* stipule; *b.* penult. leaf; *c.* scare bud.
7. Ultimate leaf with commencing stipulæ, and last leaf punctum, also a scale.

These compound leaves (i. e. Nandina) take upon them their development sooner than bipinnate, and ordinary leaves.

There is no difference between a young Bauhinia leaf and a young Hymenæa leaf.

There is no difference between young Nandina leaf, and young Aralia leaves; but the former are more perfect.

There is no connection whatever between the division of leaves and their venation.

I have examined also Fœtidia, the convolute buds of which are actually convolute *leaves*, not bud-scales, hence it differs from Rhizophoreæ; the convolution is visible in the penultimate or ultimate leaf; in the axillæ of the outermost a stalked body occurs with two conduple bracteæ, and a central four lobed-disc, evidently the very very young flower.

In Nandina domestica the circumstances are a good deal the same as in Aralia, but each pinnule instead of being simple, is pinnate.

The stipulæ are extensions of the petiole forming a cone over the young leaf, the primary pinnæ of which in the penultimate leaf, are sessile; the organ exists in the ultimate leaf, i. e. that next the punctum of the disc.

Opposite this margin of approximate union of the stipulæ, exists a large scale, i. e. in the dorsum of the axilla. This although much larger than the others, I take to be the first formed scale of the bud, which is common in the axillæ, and which were leaf buds.

This instance shews clearly that the division of the leaf is dependent upon division of the parenchyma, and quite independent of the veins, which do not exist.

The leaves in this, have a nodose irregular appearance.

Is the dorsal scale analogous to the scale or stipule? of Naiades, etc.

BAUHINIA DIPHYLLA, HYMENÆA COURBARIL, PASSIFLORA, ETC.—PLATE LVIII.

Bauhinia diphylla.—Pl. 58. I.

1. Apex of a branch with imbricated stipule.

2. Leaf and stipule of same, shewing the conduplicate terminal lobe.

3. Same younger.

4. Same terminal, lobe halved.

5. Very young leaf with one stipule.

6. Apex of the branch, one stipule deflexed, the antipenult. leaf to right, penult. to left, ultimate with its stipules at *a. a.*

7, 8, 9. Ultimate leaf; 8, penult. punctum; 9, ultimate ditto.

10. Immediate apex, stipules of antipenult. leaf removed.

11. Another antipen., penult., and ultimate leaves at 1, 2, 3. Stipulæ of one removed.

12. Immediate apex of ditto; shewing the ultimate leaf and commencement of *punctum*.

13. Another at the same period.

Hymenæa Courbaril.—Pl. 58. II.

1. Apex of axis consisting of one leaf; stipulæ removed; ultimate leaf with the stipulæ developing and terminal disc.

2. Another apex about the same period, but the stipulæ of the ultimate leaf are more developed.

3. Immediate apex of the same seen in front; *a. a.* ultimate leaf punctum; *b. b.* future stipulæ; *c.* disc.

4. Another dorsal; *a. b. c.* as before.

Passiflora incarnato-alba.—Pl. 58. III.

1. Immediate apex of axis; ultimate leaf, ultimate punctum, and disc.

2. Ultimate leaf of the same; two auriculæ indicate the future stipules.

3. Same points of axis; one leaf removed shews the penultimate leaf, ultimate ditto rather obliquely, and disc.

4. Same with one more leaf; 5, same more advanced, two lobes now.

6. Leaf more advanced, two lobes; two stipulæ and axillary disc.

7. A more advanced leaf; *a. a.* shews the lateral lobes of the pinnules; *b.* the bud in axil of stipula; *c.* future tendril.

8. More advanced, in this as in preceding; lamina commenced, and conduplicate, same figures have same references.

Results.

1. That in all three, the stipulæ are nothing but the lowest pinnulæ of the leaf.

This is probably the case with all which have alternate leaves and opposite stipulæ.

The direction of development is curious, first terminal punctum, then stipules, then intermediate pinnæ from above downwards.

2. No distinction between development of Cissus and Passiflora! in regard to leaves, stipulæ, tendril, or first steps of the bud. (?)

3. No distinction at first between flower and leaf bud; compare the stipular bud of this, with that of P. kermesina.

4. That that of Bauhinia diphylla has folium impari pinnate or trifoliatum.

In a species of Bauhinia, protecting functions are assumed by the end of the petiole, which is dilated, sub-foliaceous, as much so as the real stipulæ, and cucullate, embracing the two young pinnules!! This remains up to a latish period.

In this instance also the stipulæ from their development posterior to the leaf punctum are to be considered as the pinnules lowermost pair.

The same also occurs in Hymenæa Courbaril, the stipules are formed posteriorly to the leaf punctum, and however distinct they may be afterwards, have as in the preceding, in their very young state, exactly the appearance of a leaf tripinnulate, and are moreover evidently belonging to the leaf punctum.

Between Cissus and Passiflora there is no discrimination in developments, either of stipulæ leaves, or tendril, the axil-

lary stipuline bud however is not a flower bud, or rather was not; this species subsequently produces a leaf bud from the axil of tendril. In it the stipulæ are nothing but the lowermost lobes of the leaves.

Thus the apparent anomaly of opposite leaves in stipulæ accompanied with genuine alternate leaves, is done away with, for in Leguminosæ, Passifloreæ, and Cissi, the stipulæ are nothing but the lowermost pinnulæ!!

Apocynum cristatum.—Pl. 58. IV.

1. Apex of axis, anti-penultimate leaves and penultimate seen between them.

2. Same antipen.: leaves removed; shews one penultimate, the two ultimate, the last punctum (or the developing leaves rather), and the state of the ciliæ of ultimate pair of leaves.

3. The same in another view, one ultimate leaf removed shews the punctum or disc, and the two young leaves: *no ciliæ.*

4, 5, 6, 7. Represent leaves seen in front, shewing the development of ciliæ in their axillæ, these are deficient in No. 7, the youngest of the four stages.

8. A node, with stipuliform ciliæ.

Michelia champaca.—Pl. 58. V.

1. Ultimate leaf, *stipular* base opened, shewing the last punctum; one stipular dilatation removed.

2. The same in front, development of lamina seen.

3. Another, apex of a branch; penultimate leaf and its stipular dilatation opened out, shewing the ultimate leaf.

4. Ultimate leaf of ditto.

3*a*. Represents the same from another apex of a branch.

7. Young leaf detached spread open, to shew the evident continuity of the stipulæ with the petiole, and that the form of the parenchyma of the lamina or stipulæ does not depend upon the presence of vessels.

5. Front view of a young leaf and stipule.

6. Ditto lateral.

Leriodendron grandiflorum shews that its stipulæ belong to the leaves; firstly, by the scar which is continuous with the margins of that of the petiole; secondly, by its buds, which are imbriated with scales, the outermost of which bear on

the back near the apex, a small lamina, which gradually disappears, leaving the midrib of the petiole and its dilated margins.

Results.

That the ciliolar stipulæ of the Apocyneæ are mere cellular growths of the space of the node between the leaves, and subsequently all round.

Still they appear to be developed from the base of the leaves towards the centre of the interfolium.

They remain always ? cellular, and are sometimes as much developed as some stipulæ.

That the stipules of Michelia are dilated; parts of the petiole united with it throughout its whole length.

That these stipulæ are altogether analogous to those of Aralia, and Nandina.

That the laminar part is first developed; that the difference between these stipulæ and the lower pairs of pinnules is only one of difference of angulation of their bases.

Bruguiera, Ficus, etc.

Bruguiera Gymnorhiza.—Pl. 59. E.

1. Ultimate leaf, with nascent stipulæ.
2. Stipulæ alone.

In this as in Rubiaceæ there is no connection between the leaves and stipulæ.

In Rubiaceæ, the interpetiolar stipulæ are rudimentary leaves of independant origin; they alternate with the leaves to which they are usually referred, present generally (in Ixora, etc.) no traces of union, and the central vein is the largest. The next leaves to them *are opposed* to them ! but this may not be true opposition, which would be a strongish objection. *H. B. C., April*, 1843.

Ficus elastica.—Pl. 59. F.

3. Apex of branch.
4. Another, ditto less developed.
5. Ultimate leaf, and two stipulæ.

6. The same; one stipule reflexed, shewing the punctum, and, that they have no connection with the leaf.
7. Apex of a branch; penultimate leaf and stipules.
8. The same; leaf removed.
9. Ultimate leaf, and nascent stipules of the same; no connection or correspondence with margins.
10. The same laterally.

However much the stipules of Ficus may appear to represent stipulæ of leaves, yet the early development bears only the idea suggested by the examination of the mature line of insertion or attachment to the stem, i. e. that they occupy another plane.

In Ficus elastica, however much in those cases in which two gemma scales are developed, the appearances even up to an early period may be of stipulæ veræ, yet their original inequality, and the smaller being interior to the other arguing a different *plane* of attachment, and their very distinct original *distinctness* from the petiole, with the central line of which, not with its margins, their anterior line of segregation corresponds, proves to me that they are not stipulæ but two leaves, protecting the bud.

1st. Pair expanded—stipules.
2nd. Leaves—stipules.
3rd. Leaves—stipules.

Then bilobed disc.

The stipules of Ficus elastica are single organs, and in every respect as to development, analogous to leaves, being scales with incurved margins.

Also the second line or suture along which they separate into two distinct parts, is a result of development not making its appearance to a rather late period.

The midrib of the leaf is the first formed, indeed it is of considerable size before the lamina makes its appearance, this at first has the peculiar cellular grumous aspect of nascent cellular tissue.

The veins are a result of ulterior development, they are first mere transparent lines, first appear the secondary, then the intra-marginal.

Casuarina muricata —Pl. 59. G.

9. The leaves are in whorls, not foliaceous, but rather resembling those of Equiseti, they have apparently the veins, but this is due to the presence of a line of brown-greenish *parenchyma* on either side of midrib. They are leaves because they produce axile buds, and because they are developed as distinct puncti.

Nepenthes.—Pl. 60.

I. Punctum with an oblique base.

II. Punctum elongated, a foveola with round edges below apex; anterior part of upper part furrowed broadly.

III. Inflexion of upper margin of foveola: shadowing out of anterior cristæ.

IV. Margin more developed; lid now presenting an entrant gibbosity and two marginal gibbosities, the former soon closes up, origin of pitcher, the latter form subsequently the two veins of lid, the interior corresponds to the depressed part above the closing up gibbosity; lamina of leaf now a thin margin along anterior middle of petiole, which is very thick.

The lamina then takes on most development, the pitchers remaining rudimentary, covered with hairs, long after the leaf is perfectly developed, the midrib however goes on throughout lengthening. An intermediate change consists in its thickening upwards or becoming clavate, and then tapering again to the pitcher.

The processes of rim of *latest* development or most ulterior, therefore those with largest rims are most organized.

The 1st appearance of leaf in Nepenthes is the point as usual just below the apex. *Then* a concavity with a tendency to incurvation of upper edges.

Then a decided incurvation and the point beginning to be lengthened backwards, and deepening of the cavity.

Then deepening of cavity, prolongation of apex obliquely backwards, inflexure so as to close the cavity, the mouth of which is occupied by a white cellular pappillose pulvinus.

The parts afterwards remain much the same; the pulvinus becomes subsequent, the intervenium of lid, the fringe of margin, and the ventral? crests are later developed.

The development of the pitcher is primary, it begins before the lamina of the petiole is commenced, which is exactly as in Ficus elastica, but in this species it then becomes comparatively retarded, and so we have highly developed petioles ? with very rudimentary pitchers.

There is little reason perhaps for considering the lid as lamina, it is rather the foliaceous dilatation, and the whole pitcher is perhaps to be considered as an anomalous structure of the midrib.

But further observations on leaves, especially pinnated are required.

Nepenthes is allied to Aroidea in venation; it presents a very remarkable character of the secondary veins, not being larger than the tertiary: in the longitudinal character of the lowermost of them, it approaches Monocotyledonous venation, and particularly that of a quatic plants.

STIPULÆ.

Nothing satisfactory has as yet been said about these organs. It has struck, I believe every one, that they are modifications of leaves, with which in distribution and anatomy they often precisely agree.

See Lindley's Definitions, El. p. 29; but such an origin cannot be made to apply to many, such as the interpetiolar stipules of many Rubiaceæ, the convolute stipulæ of Ficus, etc. Because in the former they have, in the mature state, no connection with the petiole, and in the latter, they are positively above it.

In Parkinsonia aculeata, the stipules are the lower pinnules.

If they are, as Lindley says, accessory leaves, it is at once clear that they are not always double organs, as in the tribes with interpetiolary stipules, Ficus, Dipterocarpus, etc. Instances likewise occur in Rubiaceæ which are not explainable on such grounds; and further, their axils appear very rarely to produce buds.

The origin and function of these organs, although in all cases referable to the leaf, as a type, vary a good deal.

The ochrea is quite distinct, and is a mere dilatation of the petiole; the margins of the dilated part cohering and forming a sheath.

Such are all dilatations of the petiole, which may be carried so far as to produce vaginœ. Ex. Nandina, Aralia, and probably all Polygoneæ, Rosa?

2. Stipules may be independent organs, analogous in all respects to the scales of buds as in Dipterocarpeæ, Ficus, in which last they are indifferently, simple, or double.

3. They may be referred to the pinnules of leaves, of which they form necessarily the lowest pair: this view is borne out by their development. And this is probably the case with all independent bistipulate plants with alternate leaves.

Ex. Passiflora, Bucklandia? Hymenæa.

It is probable perhaps, that in some as Pouzolzia pentandra, they have two origins, in that they represent pinnules of the leaves, and also independent organs, as this plant presents entire interpetiolar stipulæ above? And the usual form below.

Stipulæ do not exist in Stellatæ, as is shewn, I think, by Rubia cordifolia, in which all the leaves of the verticel are stalked, and which do not exceed four in number. This last however only proves that they cannot be stipulæ, as generally understood, since the number then ought to be six; but they may be independent leaves, as in many Rubiaceæ, although I know no instance in which they are distinctly *stalked.*

The study of Bucklandia first led me to adopt the idea of their true nature, which is, that they are modifications of leaves, and that in all cases they are analogous to the scales of buds: and that hence they have nothing to do with the leaves to which they are supposed to belong.

This is most distinct in those species which have entire convolute stipulæ, as Ficus and Dipterocarpus, in which the attachment takes place all round the axis and above that of the petiole. Hence this view of the case does away with the unnatural idea of alternate leaves and opposite stipules due to cohesion. Thus Bucklandia becomes no longer singular on

account of the definite bud-scales, the above instances having only one. Rubiaceæ, Rhizophoreæ, etc. two or three, according to the number of leaves; many plants indefinite as Sedgwickia, Œsculus, and most northern plants. They may be, as is often the case, rudimentary, and as in some tropical forms, entirely wanting.

With regard to Rubiaceæ, I may observe further, that the midrib of each stipulæ is single and central, not double and lateral, as would be the case were they due to cohesion of two distinct leaflets;* for although Link says, that the line corresponding to the margin of union is generally vascular, it is almost invariably evascular.† The only exceptions being, I believe, in the corolla of Compositæ, as was long ago observed by Mr. Brown.

Stipules are not distinguishable from the interpetiolar processes of Apocyneæ, but by their development and cellularity?

The whole tenor of Adrien Jussieu on this head is to attribute division of the leaves and stipulæ, to the disposition of the fascicles of vessels in the stem, and their points of exit.

The function is not so variable as the origin; in all cases the organ appears protectant;in many as in Bucklandia, and Hymenæa, it is palpably so.

Very generally, therefore they are temporary organs, but they often combine as might be expected, both protecting and aërating functions.

If the stipulæ are, as defined at the base of the petiole on each side, or as attached to each side of the base of the petiole, it is, I think, inferable that the scar or cicatrix or base should be on the plane with the base of the petiole, as it is in Magnoliaceæ.

But this is not the case in Rhizophoreæ, Ficus, etc. in which, the former at least, the base or cicatrix, is evidently within, and altogether on another plane.

* See Link, p. 260, addiderim quod vera coalitio plerumque segmento nervoso nec enervio fiat.

† See Link, p. 275, where he says plerumque nervus per medium segmentum ad apicem usque decurrit, etc.

In Rhizophora, R. gymnorhiza, the developments are strictly alternate and independent; the stipulæ are only to be known by the young lamina not being contracted at the point of attachment. They alternate strictly with the leaves, to account for which an internal degree of union of the contiguous margins must be assumed, though contrary to what may be inferred from the general venation, integrity, and relative size of the vessels, and the development which shews that ab origine they are two *scales*, alternating with the preceding leaves, and from another node.*

Consequently in Rhizophora, the stipulæ are leaves, protecting buds; the species requiring that every bud, at every node, shall be so protected; every other node is foliiferous, every other gemma tegminiferous. This is also shewn by the fact that the lateral buds are sometimes—generally perhaps, protected at the base by two minute cordate scales, alternating where there are two *ordinary stipulæ*, but without corresponding leaves.

If we look again at Ficus elastica, we shall find that either the bud or stipule is furrowed longitudinally, corresponding to the centre of the axis, that the line of insertion of the stipule is plainly above that of the leaf, and that moreover there is not the slightest appearance of its margins being continuous with those of the petiole.

STIPELLÆ.

Stipellæ remain to be explained—are they, as some forms of stipulæ improperly so called, mere appendages of the petiole, as are those of Sedgwickia? They are usually deciduous, so are scales of buds. They are usually rather of a different and less foliaceous nature than leaves, so are scales of buds. They in all cases protect the bud or young elongated portion of the axis, so do scales of buds.

They rarely produce buds from their axillæ, so also is the case with scales of buds.

* (I understand *Nodes* to be clavate spathulate bodies?)

The whole subject is, however, worthy of investigation. Stellatæ should be particularly examined with this view, but it is no argument against my idea that they are ever converted into leaves, for such is the case in a greater or less degree with the inner scales of those which have imbricated bud-scales.

TENDRILS.

These organs are referred by Lindley to petioles, and by Link to branches. There is however, no doubt, that the former opinion is much nearer the truth than the latter. But instead of confining the metamorphosis to the petioles, it is more consonant to the nature of these organs to attribute it to the leaves entirely. The proof of this exists in those Cucurbitaceæ in which the tendrils are branched; the branches occasionally corresponding to the divisions of the petiole into veins in the leaves. The only objection to this view in Cucurbitaceæ is, that the leaves are not strictly opposite to the cirrhi, but this may perhaps be explained by a change in direction of the continuation of the axis. The greatest division of cirrhi takes place in some tribes (Cissi) with compound leaves : and I see no reason for supposing them to be in this order modifications of the peduncle. The idea of St. Hilaire regarding these organs in Cucurbitaceæ is not borne out by a single fact. In certain species of Smilax the lateral leaves are cirrhiform, the terminal one alone arriving at its full development. An additional instance of a cirrhus terminating a leaf, that is of the midrib becoming elongated, exists in Flagellaria indica. An instance of the petiole being narrowed into a cirrhus, and again expanding, exists in Nepenthes.

The idea that the tendrils are branches, and opposite in some cases to the leaves, may be explained by supposing the continuation of the stem or axis to be from the axis of the developed leaf, and such a case may, and does often exist, but it is quite sufficient to look at them in the pea, etc. to be at once convinced that they are modifications of leaves.

In *Smilax* development proves that the tendrils are nothing but the lowermost pinnæ of a folium tripinatum, the margins of the petiole of which, subsequently become dilated, the pinnules being outside of the dilatation which originates from the margin of base of central leaflet. Perhaps this in one of the few instances among Monocotyledones, of a pinnated leaf, and an only instance of the origin of tendrils from them.

Pl. 59. G. 1. Apex of axis of Smilax.

2. Same outer leaf removed.
3. Same outer leaf removed.
4. Same.
5. Penultimate leaf and ultimate.
6. Ultimate leaf and nascent punctum.
7. Same in front.
8. Half leaf, lateral inner view shewing that the future tendrils are nothing but the continuations of leaves.

PARASITISM OF CUSCUTA AND OROBANCHE AS APPLIED TO PHYSIOLOGY.

During a stay of a few weeks at Cabul in the year 1839, I was partly occupied in observations on the parasitism of Cuscuta, especially of a gigantic species which literally covers many of the Poplar and Singit trees along the watercourses of irrigation in that neighbourhood, and I had also opportunities of contrasting it with the Parasitism of Orobanche, on a species of Cucumis.

The species of Cuscuta that occur in Affghanisthan may be really said to be omnivorous, and fanciful it may seem, they are not the only analogies presented to us between the flora and population of that country.

The disc like suckers not only adhere to every part of the stock, with which they come in contact, being often so numerous as to appear to coalesce, but they fasten on every other plant within their reach, as well as on themselves, forming such an intricate and firm union, as to defy every mode of separation except with the knife.

I noted one specimen of the gigantic sort in which a branch of parasite, after leaving the stem, passed up the petiole, then along one margin of the leaf, then in its twist coming across a smaller leaf in the axilla of the next leaf, adhered to its footstalk, then back again to the leaf to which it first adhered, and thence passing off in quest of other prey. The large leaf did not seem to suffer, the small one was sphacelated at its apex.

In a hedge at Bamean, I observed, I believe, the same species growing on a kind of Hippophae, and attacking every other plant within its reach, here seizing, on a Hæracium, there a Hyoscyamus, on this side attacking a Willow, and lastly encroaching on a cornfield on one side of the hedge, and forming a confused mass of adhesions with the various plants along its border, not excepting the Grasses themselves.

Possibly in this case the angles so described are distinct axes! they certainly appear to be so in the sketch I have before me.

But its voracity is capable occasionally of greater extension, for if, as happens in the case of the Cabul Poplar, the surface of the wood presents out-cropping angles, offsets will be found sent to the nearest of these, from the main sucker within the bark.

The whole substance of the circumferential system of the Cuscuta appears to pass inwards, and to be expanded on the surface of the last formed wood. I did not always observe a passing in of the ligneous system, but this was evident enough in cases of parasitism on Alhagi Maurorum, and here the external system adhered to the bark of the stock.

In Orobanche the suckers have the same inclination to become mutually attached: but independently of their being confined to the roots, there is another striking difference, since the attachment takes place by the central or ligneous system alone, by means of ducts which passing off from the outermost ducts of that system, pass through the cellular external system, thence through that of the stock, terminat-

ing at the surface of the wood on which they expand in a discoid form. It would appear that at this place they are more unrollable than elsewhere.

The first observation I would make on these notes is, that we should be careful in drawing specific names from the plants to which they are supposed to be restricted. Among the many species found in Affghanisthan, I have no reason for supposing that any peculiarity affects peculiar stocks.

The occurrence of parasite Cuscuta on Monocotyledonous plants, has not, so far as I know, been observed frequently before; I regret that I did not examine the nature of the adhesions on the recent specimens; but I have found that he who travels in a new country has great difficulty in sitting down to any examination requiring patience, and remaining in doors. M. DeCandolle has noticed the similar attachment, but considered them rather as a means whereby to extend their attacks, than as a distinct of provision. *DC. Physiol. tome.* 3 *p.* 1407.

The variation in the attachment of Cuscuta and Orobanche, is deserving of further observation, the limitation in the latter instance to union by the central system appearing to me opposed to those theories founded on the supposed necessity for a greater degree of elaboration in the fluids imbibed, than in parasites furnished with proper organs of elaboration.

But this is by no means the only contradiction presented to us by these plants, which seem to me especially adapted for physiological study. For although such parasites, as Loranthus, when growing on trees the juice of which is milky, do not themselves present a similar juice, yet Lt. Kittoe found in the Forests of Orissa, a species parasitic on Strychnos Nux Vomica, the very poisonous juices of which the parasite by all accounts seems to have even concentrated in itself. Yet ordinary views of Physiology, founded on the common mode of attachment of Loranthus, would be inclined to limit its power of absorption to that of the ascending unelaborated sap.

Notes on Cuscuta and Orobanche.

Cuscuta.—One of the Affghan species of Cuscuta, is of great, indeed of almost unlimited size, as it frequently reaches to the tops of small trees, and from its composition may be supposed capable of indifinite division.

The stems which are voluble, are of the thickness of a middle-sized string, round, except at the apex, where they are generally flattened, the older parts are of a reddish tinge, the younger, of a greenish with irregular reddish spots.

It is irregularly branched: the branches are distant, suffulted by a fleshy boat-shaped similarly coloured leaf, towards their ends exist other similar but smaller leaves.

The suckers are discoid and very numerous, they seemed to be formed at almost every point of contact, and frequently present the appearance of a wavy line. Is this owing to the *confluence* of the originally distinct discs? When continuous, they present the appearance of a canalliform groove, with thickened edges.

There is something remarkable often ditinguishable in the nature of the branching. A branch being developed between that first formed and the axis, or in other words from the axilla of the first branch, which in this case retains its original size, although the secondary branch may be very long.

It seems as if the original one was the lowermost branch of the other, but still its relation to the bract, shews that the smaller one is that first formed. I do not know how to explain this: because, the leaf evidently belongs to the axis and not to the branch, as is pointed out by its lines of decurrence, although the limb is in direct relation as to origin with the base of the small branch.

Even in cases in which the inner branch would appear to be formed first, there is always the rudimentary one in the axil of the leaf.

This interferes with the only mode of explanation: viz. 1st. That the leaf suffults the outer branch, that of itself

suffulting, the inner one being abortive. *See fig.* 8, *pl.* 61. *a.* axis.

That this leaf obviously belongs to the axis, is evident from its examination in its younger stages of development, and sometimes three branches form one axil.

The branch as it becomes larger, very frequently twines round the axis, and throws out the ordinary form of suckers, by which it appears to adhere in the same manner. On detaching one of these, oblong slits remain visible on the axis, the suckers present the appearance of a white cellular looking depression, with a prominence along its centre corresponding exactly to the slit in the axis, but this prominence, on withering, assumes the appearance of a cavity. The branch is furrowed or streaked on one side, these striæ appear to originate from the axillæ. Do the suckers originate from these, or are they due to the pressure and twisting? they do not exist in the very young branches.

The anatomy of the stem. Towards the centre it is extensively (in comparison) cellular, around this cellular part is the ligneous system; this seems to consist of tubes or fibres like the external ones, but to a much greater extent.

Between this and the cuticle is another extensive cellular formation, towards the centre of which is a system of cylindrical fibres, containing air in sections, these fibres become approximated to the cutis afterwards. The cutis is thick and tough, there is no separation of parts.

The suckers adhere to every part of the willow with which they come in contact: generally, however, they are found sticking to the stem.

On the woody branches the adhesion is continuous, and the stem of the Dodder appears conspicuously margined on both sides. No *bourrelet* is formed on the willow branch.

The examination of the nature of the adhesions is rendered difficult by the short turns of the spires, and the consequent one at a degree of obliquity of the longitudinal axis of the parasite, with that of the willow.

On stripping off the bark gently, the adhesive part of the sucker is found to pass through the bark and attach itself to the wood, in which, depressions corresponding to the slits in the bark mentioned above are formed; these depressions present here and there a cellular appearance from some of the cells of the sucker remaining in adhesion. However irregularly indented the surface of the wood may be, the suckers do not penetrate its substance! although they may subsequently become imbedded in the wood by the annual additions of the layers of this.

[Are the juices the same in both? Whatever the degree of obliquity in the spire, the discs have their longest diameter parallel to the axis. Is the juice bitter?]

It is curious that the thickest part by far of a young branch of the Dodder, is that in which it is about to contract adhesions; the performance of this process appears to take some time; it is also, the only part which remains greenish.

The adhesions of the Dodder with itself are similarly disposed; the stock presents green oblong wounds; the suckers reach the woody system.

On stripping off the parasite from a branch of one and a half year's growth, the slits are very visible, running in the direction of the axis of the stock, these slits appear either distinct, or connected by a white membrane; the cuticle in most cases remains partly attached to each slit, around the margins of which it appears to be inflexed.

Cuscuta gigantea.

Inflorescentia composita paniculata, apicem versus simpliciter spicata, ramis paucifloris, flore centrali vel terminali prius evoluto. Flos diaphanus, cellularis, sepalis tubum ½-æquantibus. Corollæ tubus cylindraceus, laminâ 5-partitâ, laciniis patentibus, acutis.* Stamina faucem paulo infra inserta, apicibus subexsertis; filamentis brevibus, connectivo valde carnoso, loculis rubro-sanguineis, polline aurantia-

* The venation is as in the other species, viz. confined to the stamina; for in this, above the insertion of the filament, the corolla is evascular; so are the scales.

ceo.* Squamæ tubo basi et semet adnatæ, apicibus incurvis, integris, fimbriatis.†

Stylus unicus brevis, longitudine stigmata 2, linguiformia subulata, purpureo-sanguinea æquans. Ovarium basi solidum et viride, evasculum, cæterum cellulosum, albuminosum, biloculare, ovulis cujusque loculi 2, erectis, foraminis situs hilum prope, tegumento 0 discreto.

Æstivatio leviter imbricata, apicibus leviter inflexis.

This species is just coming into flower, it is conspicuous from its size and its colour.

The specific characters can only be drawn from the inflorescence and envelopes of the sexual organs, no peculiarity appearing capable of detection in the axis and its appendages. The stigmata in this species have precisely the same structure as in the last, and present no furrow down their inner face, or any symptom of deficiency of stigmatic tissue on the outer, both curious anomalies.

This species although very generally found on a species of Salix, up which it climbs to a considerable height, also occurs on Populus, and in one instance on Elæagnus *Sinjit*. On the poplar its effects were evidently deleterious, although the tree from its greater size might be supposed better able to withstand its effects than the Salix. The effects on the only branch of the Sinjit to which it had become attached, were also injurious. The parasite not being limited to one species, is a proof that it eliminates its own food, that is, it alters the juice of the stock. The presence of Strychnine in its Viscum is no proof to the contrary. The Strychnine may be the only material in the Viscum that exists, correspondingly in the stock.

From the wounds of adhesion, the Sinjit exudes its fluids, which subsequently assume the form of a laminated transparent gum, not unfrequently assuming the form of a fungoid excrescence.

* Pollen nothing remarkable under $\frac{1}{10}$th.

† Adhere to tube for a little distance above its base; and up to this also adhere together.

Adhesion also to the corolla, and probably to every thing with which it may chance to come in contact. The branches and stems are excessively long and pendulous; marks of adhesion may be found on stocks of many years' growth.

Cuscuta gigantea. Pl. 61.

Fig. 1. Young stem transverse section.

,, 2. Ditto longitudinal section, passes obliquely through the sucker.

,, 3. Transverse section of mature stem, through a sucker.

,, 4. Transverse ditto carried through a sucker of another stem of Cuscuta.

,, 5. Longitudinal section of stock, Salix sp. and sucker, and stem of Cuscuta. (This is a *plan* for the sucker being oblique, cannot be represented longitudinally with a longitudinal section of stock.)

,, 6. Longitudinal section of No. 4.

,, 7. Longitudinal section of stock and sucker.

Elæagnus. Sinjit. Pl. 61. *fig.* 9.

a. External system, *Cuscuta*.

b. Woody external system, not a central section, but parts of the pith ought to be represented.

c. This space was filled with gelatinous fluid.

d. Bark of *Elæagnus*.

e. Receptacles of gum.

f. Wood.

g. Pith.

Remarks on the sketch.—The external system or bark of the Dodder presents on a longitudinal section, a cellulo-gelatinous appearance.

The cells seen in the sketch, one muriform and forming right angles with the woody system, are curious, perhaps they were part of a sucker forming, for that part of a sucker near it has the usual tissue. The sucker would appear to present the form of a narrow disc, not expanding.

Of the limits of the bark and wood of Elæagnus, I am not certain, no separation taking place besides the rays of the

wood evidently form the walls of the spaces which seem filled with gummy fluid matter. The wood, which would appear of one year's growth and a little more, has two rather irregular lines of ductiform vessels, but is otherwise fibrous.

In Populus the same occurs, the disc coming into contact with the external surface of the layer of wood, formed immediately before (?)

In this the remarkable circumstance of other axes being formed, takes place; and it is curious that in this instance, the sucker was divided inside the bark, one leg divaricate to the additional axis, the other following the usual course. In this there is an appearance of a central system of the sucker.

Sketch of Populus tomentosa. Pl. 61. *fig.* 10.

a. Cutis.
b. Cellular system of bark.
c. Just forming wood.
dd. Just formed wood.
e. Last year's wood.
f. A fuscous band—what is it?
g. Extra axis.
h. Leg of sucker.

In this also the bark and wood form a continuous system, though the one separates pretty readily from the other. The newest formed wood separates with the bark with which it forms an integral part; immediately external to it as in Elæagnus, exists what appear to be reservoirs of gummy matter, the partitions which are continuous with the medullary rays separating, although always originally continuous throughout. These gummy looking places are no doubt the new wood, the septa are reduced in size by the growth of the wood, and become medullary rays.

The distinct axis is most probably an error, the true structure is this, the stem is prominently angular, and the angular nature affects every system except that of the pith. Thus the bark is angular, into these angles rounded bastions of wood enter, and into these woody portions enters the fuscous system next the pith, so that the specimen drawn was very deceptive, for, it having been torn across the end of the

entering angle of the fuscous system, closely represented a pith, and the deception was carried on by the separation of the bark from the wood while making the section, and by the incompletion of the section itself.

Although the stems of the Dodder adhere so strongly throughout the line of contact with each other, that the stem tears along its substance sooner than it quits its hold at any point, yet there is no continuity of structure, the adhesion between the disc and the outer and the central system is much the strongest, and if there be any interchange of structure, it may be between the outer system of both plants.

This plant, is found also on Alhagi maurorum or the Shootur Kari of Khorassan, attachment in the same way. The central system is inflected also which alters the whole case considerably, the external system adheres to the bark of the stock: it now remains to ascertain whether both are inflected in Orobanche.

Orobanche, species?—Erecta spithamæa pedalisve robusta, pubescens.

Caulis basin versus ramosus. Folia squamiformia fusco-tincta.

Flores racemoso-spicati, infimis nempe pedicellatis reliquis sessillibus, bractea lanceolata brunnea vel fusca; suffulti; bracteolis 2, aliis linearibus utrinque calycis.

Calyx albus, tubo subovato ad mediam partito, laciniis acuminatis, patentibus, erectis.

Corolla ascendens, cærulea, cristis albis, tubo infundibuliformi, faucem calycis prope angustato, carinato, dorso subtus bicanaliculato; lamina bilabiata, labio superiore paulo minore, bifido, infer. 3-lobo, lobis rotundatis, irregulariter dentatis, cristis rotundatis binis, conspicuis.

Genitalia, inclusa.* Antheræ villosæ, rudimento quintæ nullo.

Cabul: in fields.

At Ghuzni, found growing on Cucumis sativa or Melon.

In one instance the stigma was 3-lobed, the ovary had 3-placentæ, the third being *posticous;* another flower had only one crest.

* Stamina basi lutescentia.

The parasitism on this presents a considerable difference from that of Cuscuta, in the first place it is limited to the radical system; in the second place the absorption of the juices is effected by the central, not by the circumferential system.

The roots consist of a central vascular fascicle of ducts, this is surrounded by cellular tissue, containing a great quantity of amylaceous granules, as usual very irregular in size.

These granules only, however, exist in abundance about the suckers.

Of each sucker a *gonflement* takes place, and the face of the root is applied to *the root* in the shape of a disc, which has no determinate direction with respect to the root to which it is attached. From the fascicle of ducts opposite the centre of the swelling, ducts pass of, penetrating through the outer system of the root of the nourisher, and expanding in the form of a *pate d'oie* on the outside of its ligneous system, and at this part the ducts are unrollable, elsewhere except perhaps towards the ends of the radicles, they are not so.

Pl. 61. *figs.* 11, 12.

11*a*. Outer system of stock and mode of expansion of ducts.

11*b*. Central and outer system (on one side) of the stock and adhering ducts of the parasite.

12. Mode of adhesion. *Wood* filled with granules.

Here again we receive light on an obscure physiological point, viz. the functions of ducts. As the attachment exists only by means of ducts, it follows that ducts in this plant, are the only organs of what is analogous to the ordinary radicular absorption.

There is a similar tendency to mutual adhesion between the radicles of the parasite as in Cuscuta.

The radicles are very brittle, and were anastomosed in one instance, such is easily imaginable provided the sucker's neck becomes elongated.

I do not know on what plant the specimen from which the sketches were made was growing, as nothing but its root, (which was an exorhizal fibrous one,) was detectable.

Do all plants, parasitical on roots, adhere in this manner? If so, there is a marked distinction between them and those adhering to stems. If so also the runners of Loranthus are stems, as is pointed out by their producing leaf-bearing branches.

Parasitical on the Riskah of Affghanisthan.

The consideration of these parasites, which resemble in their mode of attachment those species of Loranthus which have many suckers, will instruct us negatively on several points of vegetable physiology.

It is at once evident that the parasite is not nourished by the ascending juices, for its absorbing points reach only to the surface of the latest formed wood. It is also equally evident, that it can only be nourished by the descending juices during the first year; that is, if the original absorbing surface of the concave papillose face or disc of the sucker, always remains the chief passage of nourishment, since in such cases the descending juices can no longer be in contact with the concave and papillose face of the disc. But to remedy this, if a remedy be required, such other parts of the immersed sucker as may be in contact with the last formed wood, may be absorbing.*

The idea that parasitical plants may be nourished by the juices of other plants, without undergoing any process of digestion, is contrary to every analogy of the animal kingdom, and yet digestion is as universal in vegetables as in animals. Their supposed deficiency in stomata may have led to this opinion; and it is only one of many proofs of how easily an ingenious theory may be adapted to views founded on false observation, that it has since been found that many, perhaps all, of the plants, to which stomata were denied, *do* possess them in one form or another.

The proof, supposed to have been derived from certain parasitical parts allowing the passage of a solution of prus-

* The reasoning of this Para. is grounded on the supposition of the truth of the prevailing theory of vegetable circulation.

siate of potass into their tissue from stocks impregnated by that liquid, is of very limited value, for it is not to be doubted, but that the suckers of these plants are equally endowed with that property of detection, which we know to be possessed by the ordinary form of roots.

In an abstract of a paper read by Mr. Bowman on a supposed new species of Dodder, indigenous to England, and called by him C. Epilina, there are some passages which require remark. It is doubtful perhaps whether a mere superabundance of juice, constituting succulence, can be a source of nourishment to any neighbouring part, the chief growth of which takes place at a time when the ordinary supplies are much diminished.

In all the most conspicuous instances of the presence of reservoirs of nourishment, it is in the shape of fæcula or amylaceous granules that it is to be found.

No plant directly elaborates its juice from the soil, the generality draw their supplies directly from this source; but the elaboration is a subsequent function.

The last part of the abstract alluded to is a decided error: green colour is neither dependent on the presence of stomata, nor strange to say of light, (many embryos are green.) Hundreds of plants exist, which present saturated green colour, but have no stomata: of this, water plants and the leaves of mosses are instances.

The presence of stomata may depend on the thickness of the layers of cells containing green globules: in mosses the leaves consist of a simple series of cells, but the base of the apophysis, which has in its younger state a dense green parenchyma, has stomata.

Additional Note on the Development of the Flower.

SINAPIS.—PLATE 62.—FIG. III.

a.—Represents the young ovarium of Sinapis; it has four distinct equal undulations at the points, and the lines pointing out the future placentæ are four.

In true bicarpellary structures the undulations are only two, or at any rate two are subordinate; and there are only two lines of confluence.

If Cruciferæ were bicarpellary, the lines would be either at *c*. or at *d, d.*

a. Inner Sepal.

b. Outer Sepal.

f.—Represents a very early stage; the sepals are complete as to form and imbrication.

g.—The petals are a posterior development, and are extremely small when the anthers are perfectly marked out at a stage a little antecedent to that of figure *b*, and then also the four lines of confluence reach to the bottom nearly of the ovary, and its quaternary appearance is even more distinct: in this instance, the flat face of the ovary was opposite the outer sepals, so it was in another instance, and so it is always?

h.—In this instance there did not appear to be any petals; the staminal lobes seemed to be two outer, and four inner; and the ovary was represented by an elevation with an entire rim, flattened in the direction of the outer sepals. Outer sepal, *h*.

Under $\frac{1}{10}$th, the ovarial apex presents traces of its lobes; it is stalked and fungiform.

i, i.—Very early, sepals open: centre consisting of a convex, rugose, undivided, cellular disc.

The first change in this occurs in the marking out of the stamina, but I do not know whether there is any difference in the period or degree.

k.—Stigma much more developed. The upper ovula are most developed, and the lower are without the annulus; the upper with it, and beginning to turn on themselves.

Vessels four, about equal, if bicarpellary, these should be six.

This will however, require strict comparison with numerous other instances; it is not the first time in which I have seen the rim of the ovarial orifice entire. Compare also the size of the vessels, and compare in every respect.

My impression is, that Cruciferæ are 4-carpellary, and that the possibility of the abortion of the *lamina* of carpellary leaves is pointed out by Escholtzia or Chryseis, in which there are certainly 4 stigmata, and 4 carpellary leaves; two of which are as in Cruciferæ, reduced to narrow placentiferous strips.

Serampore, November 13*th*, 1841.

CUCURBITA.—PLATE 62.—FIG. IV.

a.—In the *Kunkree*, Cucurbita, the triangular placentæ will be found when the bud is 3½ lines, to run up into the lobes next the lines of greatest separation of the stigmatic divisions.

b.—This stage is too late to determine the question, for cohesion has taken place between all the stigmata. Do these prove the real stigmata? A transverse section of the same shews a great similarity to a leaf turned in: outward, the axis too has something that looks much like a vascular bundle.

c.—The lesser stigmatic sinuses again, correspond to the line of approximation of the triangular placentæ; these stigmatic lobes will, I think, prove to be the true stigmata, and if so, it will be fatal to Wight's views on this point, because the style will then alternate with the supposed carpellary leaves.

The section of the stigma at maturity undoubtedly represents a similar apparent inversion, the edges being turned in, so that each style has a cavity to which the stigmatic surface reaches along the line of inflexion, but terminating at the edge of the margin: the remaining surface of the cavity is not stigmatic; and what is worthy of attention is, that it is lined with hairs, analogous to those of the tube of the calyx.

It is also remarkable, that there is no dorsal vessel to what appears to be the style, although otherwise it is highly vascular.

The stigmatic canal itself is ordinarily constituted, it has as many rounded angles as there are carpellary leaves, the faces corresponding with the actual lobes of the style, the angles, with the lines between the placentæ. Its whole surface is stigmatic.

We must therefore allow that the styles of this plant are laminar, and that the laminæ are folded inwards, the stigmatic surfaces occupying the laminæ, with the exception of the space left by the incurvation.

The venation shews that these stigmata are analogous to other dilated ones. The posterior dorsal vessel appears to be wanting from having branched off, the vessels on a transverse section having an oblique appearance. What can be the use of this extension of stigmatic surface *leading no where?* for the incurved cavities have no communication with the stigmatic canal, except upwards. It is curious that the chief stigmatic action was in one case confined to the lower part of the stigma.

The only communication with this canal, takes place between the lobes.

This therefore would lead me to infer, that the real stigmata are, as I previously supposed, and that the lobes are compound, which will account for the want of a dorsal vein, and also for the cavities not leading anywhere.

d.—Apparent stigma, but not the true one.

[In ÆGINETIA, PLATE 62, FIG. 1, the stigmatic surface lines all the dilated fungiform apex of the style. Leading into the *open* canal it is velvety, the posterior stigma is the smaller: there is scarcely any tendency to cohesion between the two stigmata, but the posterior and larger one has a tendency to be lobed.

The anthers are very large, and very much developed at an early period: although bilocular, they are not of the usual quadrilocular type. The upper pair have instead of the other cell which they ought to have, a large fleshy process, somewhat *divaricating;* the lower have none.

The young anthers are perhaps a little unilateral, which would also appear to shew that they are quadrilateral?

The upper loculus of each is abortive.

The irregularity commences when the corolla is 1½ to 2 lines long, at which time the imbrication is very evident, the corolla at this time does not half fill the cavity of the calyx in

length. The anthers are lateral with respect to the filament if regard be had to their relation of aspect with the corolla; at this time they are very much developed, and the upper ones have the lobe.

At one line long, they can scarcely be called irregular. The barren cell is present.

Throughout, the two anthers look different ways: the lower looks to the ovary; the upper looks upwards, or rather obliquely.

Irregularity first appears in obliquity of the top of corolla, the upper lip being the highest, though originally simple. The pistilla are not united at the top of the margins; below, they are thickly inflected.

At calyx $1\frac{1}{2}$ line: the 5th lobe of the corolla which is open, is the most incurved; the tube obsolete.

A. Pl. 62, *(Æginetia continued.)*

a. Anthers detached.

b. Upper.

c. The anthers evidently point to the most inflexed lacinii, when lateral gibbosity appears.

d. No vestige of ovary, centre a little convex: irregularity among the petals. Sepals at this period separable, but greatly in advance in development.

e. One erect and longer; the lower diameter greatest across the two staminal points.

f. Convex disc, an irregular margin occurs here as if a petal was developed outside, at *f.*

g. Outline as seen vertically.

h. Calyx. Posterior flat margin.

i. Anteriorly convex, biparted.

B.—Calyx at a still earlier period; *k.* posterior side; *l.* convex base oblique; *m.* posterior face of cell; *n.* convex.

C.—Two large very fleshy, two upper staminal points, also large; disc very convex.

D.—Very young calyx; *a.* anterior—two lateral scales not approached by the margins; *b.* posterior.

c. Vertical convex, no other than the lateral points; cavity contains a small pointless disc.

E.—Vertical of still younger; *u*. anterior; *t*. posterior.

F.—Calyx anterior; *a*. convex, the inflexed edge becomes the future placentæ, *b*.

G.—*c*. Upper stamens very large, lower petal much larger, actually veined, and petaliform, that is, more laminar.

d. Very oblique rim of pistilla, point entire perhaps leading to lateral separation.

H.—*e*. Anterior convex.

f. Posterior.

g. Outer.

h. Posterior.

Is the posterior tooth to be supposed to be inflexed, forming a vault over the young genitalia? but this is extraordinary, for I see nothing like original distinction.

I.—The placentæ are distinct, the carpellary margins quite diverging almost from the point of inflection, they are very much lobed longitudinally. The whole, except the reflected marginal or laminar part, is covered with ovula; the lobes which are contiguous, fit into each other.

Style—vascular fascicles 2, anterior and posterior: vessels of carpellary leaf marginal placentary.

i. Vessel—ovules laxly cellular; just turning, with a minute conical nucleus projecting, *m*. $\frac{1}{10}$th.

At expansion the foramen is exceedingly indistinct: and testa cells gorged with amylaceous granules.

The early composition of the calyx, I certainly do not understand.

In other points it presents no great peculiarity.

——Examine other spathaceous calyces. The distinction of the placenta bears upon Dr. Wight's views of the structure of Curcubitaceæ.]

END OF PART I.

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TO

NOTULÆ.

PART I.

DEVELOPMENT OF THE FLOWER, Etc.

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